Herbert A. Pratt
452 Main St.
Worcester
Mass.

Eclipse Windmills,

·CHARLES·J·JAGER·CO·
174
High St.,
Boston,
Mass.

ILLUSTRATED CATALOGUE

OF

WINDMILLS,

. . Tanks . and . Pumps . .

AS APPLIED TO

WATER SUPPLY SYSTEMS,

ALSO

Windmills as Adapted for Power.

CHARLES J. JAGER COMPANY,

174 High Street, Boston, Mass.

To our Patrons.

This catalogue is issued particularly for those customers who are interested in, or who are contemplating the introduction of a Water-Supply System, and in Windmills, used either for power or in connection with a water system, and is designed to answer the inquiries of that trade without reference to the other lines of goods that we handle; our lines of Pumps, aside from those connected directly with windmill work, we do not touch on at all, nor do we, except in a very brief way, make any mention of our Gas and Gasolene Engines, which are now forming a considerable part of our trade. We issue special catalogues on these goods, and on those listed below, and are pleased to mail any or all to any one upon application; we are glad to answer any questions, and to give further information regarding the same to any one wishing it.

Prices on the different Windmills, Towers, Tanks, etc., may be found on the pages descriptive of those goods, and also in the summary at the last of the book.

In addition to the above mentioned, our full line includes:

The Fairbanks-Morse Gas and Gasolene Engines, in eight sizes, developing 1 to 75 actual horse-power. These engines are adapted to any work on the farm or in the factory.

Tanks, Dye Vats and Tubs for manufacturers.

Hand Pumps of All Kinds for shallow and deep wells, for use indoors or out, Single and Double-Acting. Anti-Freezing and Force Pumps.

Spraying Pumps, Cylinders and Pump Standards.

Power Pumps and Hydraulic Rams.

Steam Pumps and Underwriters' Fire Pumps.

Triplex Power Pumps.

Eclipse Friction Clutch Pulleys and Cut-Off Couplings.

Pipe, Fittings, Valves, Tank Fixtures and Water-Supply Materials of all kinds.

14-Ft. Eclipse Windmill with 5,000-Gal. Frost-Proofed Tank on 40-Ft. Tower.

Erected on Estate of HOWARD MARSTON, Esq., Centreville, Mass.

The Mill pumps from a well driven 55 feet from the surface of the ground, furnishing water for house, stable, lawns and gardens.

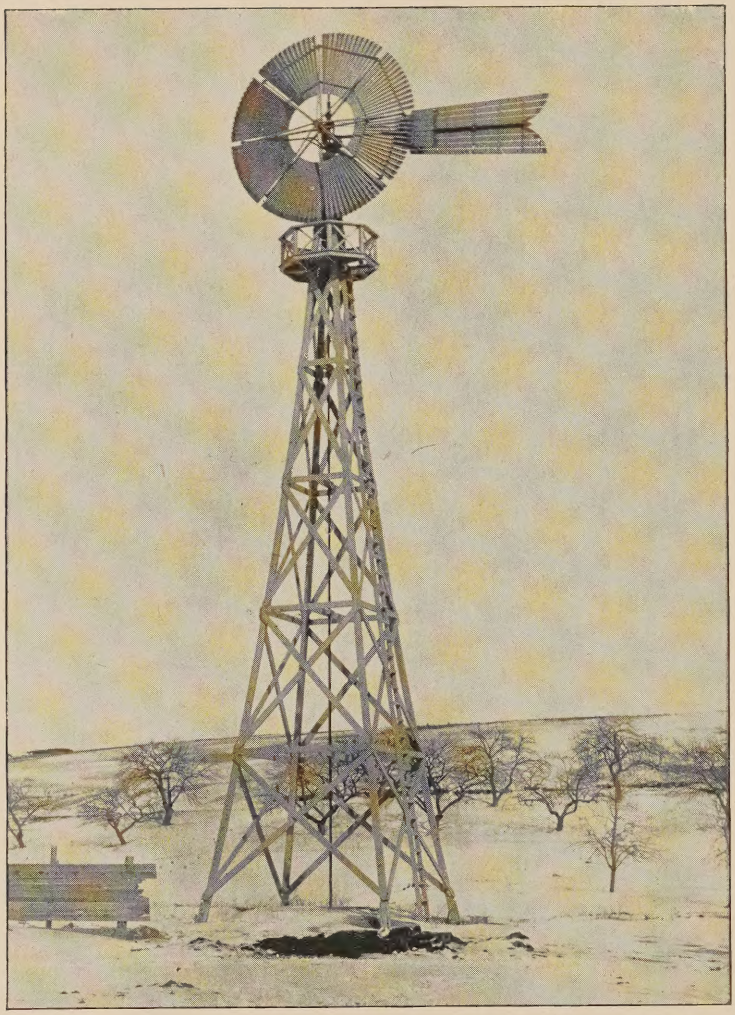
Suggestions to Purchasers of Windmills.

The principal service to which the windmill is applied is the pumping of water for ordinary domestic purposes, but its range of adaptability for work has been extended, so that they are now used to supply large quantities of water for towns and villages, isolated institutions requiring independent water-supply systems, market gardens and farms, seashore and summer cottages, for irrigating and draining land, including cranberry bogs, clay pits, etc., and general pumping duty.

Within recent years great progress has been made in the utilization of wind-power for operating machinery for various purposes, such as grinding grain, polishing marble, granite, etc., sawing wood, cutting feed and ensilage, and general farm work, while the latest triumph of the art has been the successful combination of the Eclipse Windmill and a dynamo for the purpose of generating electricity for lighting and power, this result having been brought about only after much careful thought and experiment. The time is not far distant when this field will be a most important branch of our work, and we invite inquiry regarding our power mills, and will be pleased to afford any information at our command. The value of an independent water-supply system where the advantages of municipal service cannot be had is never fully appreciated until it is enjoyed, and the introduction of independent outfits for this purpose has never before been the object of such careful attention by experts of long experience as at the present time. The demand for durable, practical, and efficient outfits has called into this line the efforts of the best talent in the mechanical field, and the complete windmill water-supply system of to-day is the embodiment of good planning and thorough workmanship.

The windmill is different from a great many machines, in that it is not complete for service when it is purchased. It must be erected on a tower or support varying in height according to the peculiarities of the location, and when so placed, attached to a more or less complex system of pump and piping connections. The capacity, weight, and frost-proofing of a storage tank must be considered, its proper location and support carefully arranged for, and the pump and piping protected from frost, if the outfit is to be used during the winter months.

It sometimes happens that a customer applies to a manufacturer at a distance for information concerning a windwill water-supply system, in response to advertisements making exaggerated claims for the special merits of his particular machine, and is informed that he can get a low factory price by sending for a mill at once, being assured that the ordinary mechanic can erect it in a satisfactory manner. In this way many customers are led on to conclude a purchase which proves to be much more expensive than they had at first anticipated, and when finished is insufficient for their needs, representing their own inexperience and that of the chance mechanics they employ.



14-Foot Eclipse Windmill on 60-Foot Spiked Tower.

Erected on Estate of J. B. SHURTLEFF, Esq., Revere, Mass.

The Mill pumps water from a surface spring into the tank shown on page 60, which is 1,100 feet distant, and 115 feet higher than the source of supply.

It is a poor compensation for the customer to reflect that he purchased the mill at the saving of a few dollars, when its operation is compromised at the start by improper erection, not only rendering it liable to wreckage and repair, but resulting in an insufficient supply of water at times when most needed, extra expense because of the employ of inexperienced workmen, and the annoyance of an unsatisfactory, short-lived outfit, which must be soon repaired, if not entirely thrown away. It has been found that the satisfactory way to arrange for the installation of a windmill outfit is to employ a competent man to examine the location and make plans and estimate for the work, as this ensures a successful result. We employ a full corps of capable men for this purpose, and when the work is left in their charge we will guarantee satisfactory results. This system gives our customers the benefits of long experience in the planning of the proposed work, enables them to accomplish results at a minimum expense at first cost, and ensures the purchase of an outfit well calculated to serve the purpose for which it is intended, and capable of doing satisfactory service during a long time with the least wear and tear.

Where it is not feasible to consult an expert, or for the purpose of procuring an approximate estimate : —

Parties wishing Estimates on Water-Supply Outfits are requested to state : —

1. The depth of the well or spring, (surface of platform or ground to bottom), from which water is to be taken.

2. Depth of water.

3. The elevation, (above platform of well), to which water is to be raised.

4. The distance from well or spring to the place where water is to be discharged.

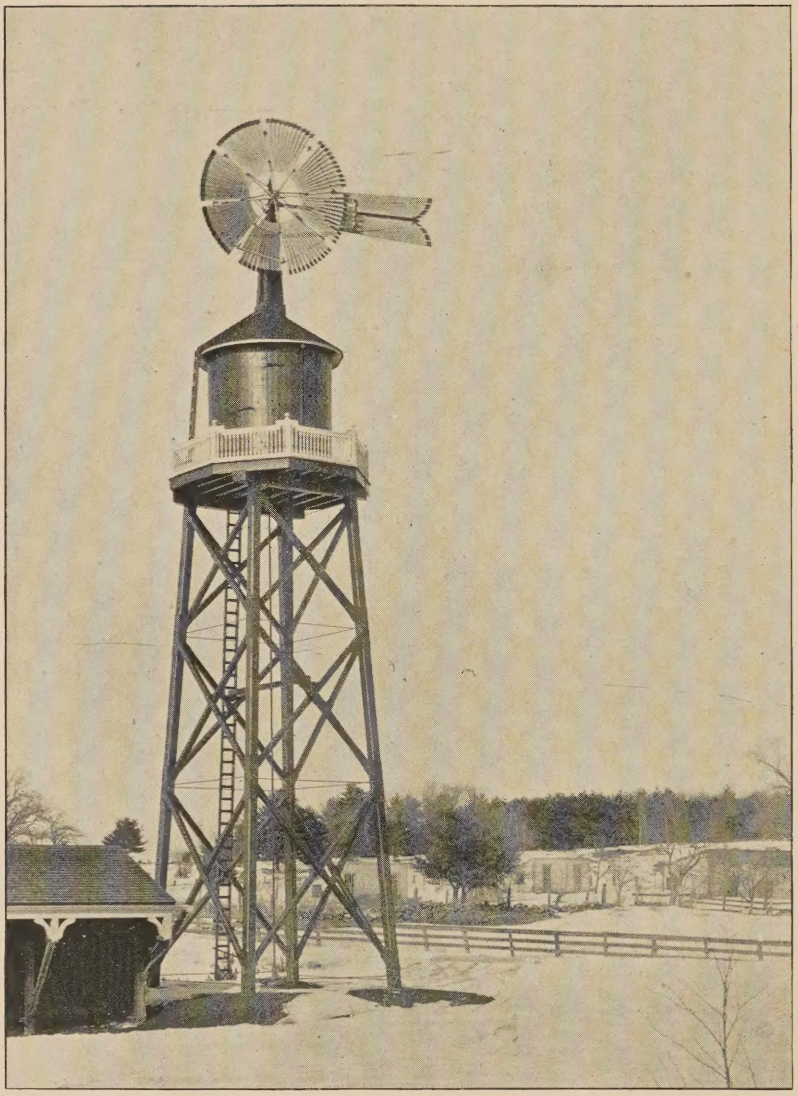
5. If a bored well, give the diameter.

6. Give the obstructions to a free current of air in the vicinity of where the mill is to be set; if well is in a valley, it is advisable to make a diagram of the same.

7. State what number of gallons of water will be required per day; also quantity of water that spring or well will afford if the supply is somewhat limited.

8. The distance of well or spring from the place of proposed location of the mill.

We will be glad to mail catalogues or reply to any questions concerning these matters, and will make estimate and submit plans for proposed work without charge. We have every facility for the complete installation of a water-supply system, and carry in stock a full line of supplies for the same.



12-Foot Eclipse Windmill and 5,000-Gallon Tank on 40-Foot Framed and Rodded Tower.

Erected at the TALBOT MEMORIAL HALL AND LIBRARY, North Billerica, Mass.

This Mill supplies the water used for the buildings and grounds.

The Working Value of the Wind.

It is our opinion that in nearly all classes of work the efficiency and capacities of the machines, or the work that may be expected of the article under discussion, is, if not overestimated, placed at the maximum. It is taken for granted that every condition is favorable to the best results, that expert supervision is provided, that all appurtenances are of the best, etc., and in this way a customer expects, and rightly, more from his machine than he can get, and in figuring up how much he requires, makes too low an estimate and is consequently disappointed with his investment.

We endeavor in the statements made below to give a clear, intelligent idea of real, practical results, such as are obtained every day; actual results instead of theoretical; average results instead of maximum; and in order to give no wrong or exaggerated impressions, make our statements a little below rather than above the average. We believe in having too much power rather than to fall short of what is required; to have a little too much water than not quite enough, for simply in this lies the fact of success or failure. We shall endeavor to so plan our outfits that our customers' needs at the most important moment will be fully met, for while the overestimated outfit will supply the ordinary requirements, it will fail utterly when the needs for a full supply become urgent; the very time when it should be of the best service its inefficiency becomes a source of loss and annoyance.

A windmill is of course entirely dependent, and relies wholly upon the wind for its power; inasmuch as the wind does not blow all the time, the mill cannot be counted upon as being always in motion. A conservative estimate of the number of hours a day that windmills may be depended on for actual, steady and productive work is eight, taking the average throughout the year; there are, though very seldom, intervals of three days in which there will be no wind, or at least not enough to obtain any effective work from the mill, and in making our estimate for storage tanks we allow for three to four days' supply. It requires a wind of 8 to 10 miles velocity per hour to obtain results from a pumping mill that are entirely satisfactory; in a 4 to 8-mile wind the mill will pump slowly, the best results being obtained in a 12 to 15-mile breeze. For a geared windmill, from 15 to 25 miles velocity of wind per hour is necessary for the best results, in such work as sawing wood, cutting feed, grinding grain, etc. It will be seen that a pumping mill can be used more constantly than a geared mill. No question is more frequently asked by those interested in the purchase of windmills than as to their capacity to do the work to which they are to be applied. A reply to such inquiries is made all the more difficult because they are put in terms used to designate the capacity of other machinery, such as those run by steam or water power: —

For example, it is asked, "How many gallons will your windmill pump an hour, or what horse-power do you estimate it at"? These persons entirely over-

10-Foot Eclipse Windmill with Rock-Shaft Connections in Barn.

Erected for BENJAMIN S. KENRICK, Esq., Dover, Mass

The Mill pumps water from a well about 400 feet distant, and 12 feet below level of barn cellar, supplying dairy farm.

look the peculiarities of wind power and the conditions of its successful utilization. Wind is a variable motor. Its efficiency, therefore, cannot be computed by the application of any general mechanical principles. Whatever conclusions are reached in regard to its pumping efficiency, must be arrived at by a careful averaging of records of windmills and their observed performances. The science of applied wind power is purely empirical. Any calculations, therefore, that proceed upon the assumption of fixed quantities, must necessarily be misleading.

The usual way in which wind power has been tabulated, is by giving its pumping capacity in a 16 or 20-mile wind. Such tables are of no practical value to the inquirer, because he does not know to what extent these winds prevail, nor is he able to estimate the proportionate efficiency of other winds that are not in the table.

We give below the estimated capacity of our windmills in the average winds, at an average speed, with pumps of sufficient size to utilize to the best advantage the power of the mill, lifting water 75 feet high through 500 feet of pipe of suitable capacity, properly connected. This is about the average load on windmills in this section.

TABLE NO. 1.

Diameter of Windmill.	Size of Pump.	Gallons per Hour.	Average Revolutions of Windmill per Minute.
$8\frac{1}{2}$ feet.	2 by 4 single acting.	98	30
10 "	$2\frac{1}{2}$ " 5 "	191	30
12 "	3 " 5 "	257	28
14 "	4 " 8 "	368	25
16 "	3 " 8 double acting.	735	25
18 "	4 " 8 "	1,044	20
20 "	4 " 10 "	1,304	20
25 "	5 " 12 "	1,958	16
30 "	5 " 16 "	2,284	14

This speed would be developed in about a 10-mile wind.

Also table showing the wind pressure at different velocities.

TABLE NO. 2.

Description of Wind.	Velocity.		Pressure per Square Foot in Lbs.
	Mls. per Hour.	Ft. per Minute.	
Hardly observable.	1	88	.005 or about $\frac{1}{12}$ of an ounce.
Just perceptible.	$\frac{2}{3}$	176-264.02	.045 " $\frac{1}{3}$-$\frac{3}{4}$ " "
Light breeze.	4	352	.08 " 1-$\frac{3}{4}$ ounces.
Gentle, pleasant wind.	5	440	.125 " 2 "
Fresh breeze.	10	880	.5 " 8 "
Brisk blow.	15	1,320	1.125 " 1 lb.$\frac{2}{16}$ "
Strong wind.	20	1,760	2.
Very strong wind.	25	2,200	3.125

14-Foot Eclipse Windmill and 5,000-Gallon Frost-Proofed Tank on 28-Foot Framed and Rodded Tower.

Erected on Estate of N. P. HAMLIN, Esq., Wayland, Mass.

The Mill pumps water from artesian well 253 feet deep; the cylinder of the pump is located 225 feet below the surface of the ground.

TABLE NO. 2.—*Concluded.*

Description of Wind.	Velocity.		Pressure per Square Ft. in Lbs.
	Mls. per Hour.	Ft. per Minute.	
High wind.	30	2,640	4.5
"	35	3,080	6.125
Very high wind.	40	3,520	8.
Gale.	50	4,400	12.5
Violent gale.	60	5,280	18.
Hurricane.	80	7,040	32.
Tornado.	100	8,800	

From the above table it will be seen that with a velocity of 4 or 5 miles per hour, the pressure is less than 2 ounces per square foot of wind surface, and that its effective force depends entirely on the velocity.

TABLE NO. 3.

THE RECORD FOR THE LAST THREE YEARS OF THE AVERAGE VELOCITY OF THE WIND IN MILES PER HOUR, AT THE U. S. WEATHER BUREAU IN BOSTON.

	1892.	1893.	1894.
January.	12.50	11.58	12.25
February.	11.67	14.08	13.04
March.	15.88	13.15	12.04
April.	12.46	11.96	13.62
May.	12.42	11.50	10.90
June.	11 96	9.50	10.54
July.	9.58	10.54	9.37
August.	10.00	10.21	9.46
September.	10.71	10.54	9.28
October.	11.13	10.71	11.92
November.	12.58	11.29	12.17
December.	12.04	11.79	11.38
Totals.	142.93	136.85	135.97
Average.	11.92	11.40	11.33

The conformation of the ground in the immediate vicinity of a windmill is a very important element in the question of its proper location, and in this connection, we suggest that the common mistake in erecting a windmill is to place it on too low a support; the ground currents of the wind being more or less broken and eddying, while the higher currents are strong and steady. It sometimes happens that a windmill plant is a failure simply because the mill is not properly located above the surrounding wind obstructions. A windmill may fail to do good work with a wind blowing from a certain direction, owing to obstructions not readily apparent, while the same velocity of wind from the other points of the compass give maximum results.

10-Foot Eclipse Windmill and 2,200-Gallon Tank on 30-Foot Enclosed Tower.

Erected at Summer Residence of CHARLES A. KING, Esq., Mattapoisett, Mass.

Pumping water from driven wells at base of tower, supplying house, stable and lawns.

In the summer of '93 we erected a 14 ft.-mill on a 75 ft.-tower, connecting the mill to a 3 x 8 single-acting pump, and made a test of its performance by keeping a record of the number of revolutions made by the mill for a period of ten days' time. The following table shows the direction and average velocity of the wind, and the recorded performance of the mill, giving the number of gallons pumped daily, the record being taken at 8 A. M. each day.

TABLE NO. 4.

FROM 8 A. M. TO 8 A. M. ON THE FOLLOWING DATES :

	Revolutions Made.	Gallons Pumped.	Average Wind Velocity.	General Direction.
Feb. 2 to 3	11,308	2,768	11.5	W.
" 3 " 4	10,054	2,461	10.4	N.
" 4 " 5	19,462	4,764	12.3	N.
" 5 " 6	3,019	739	9.2	S. W.
" 6 " 7	4,024	985	13.3	S. W.
" 7 " 8	20,203	4,945	12.6	W.
" 8 " 9	8,893	2,177	10.7	N. E.
" 9 " 10	32,122	7,863	13.5	E.
" 10 " 11	21,735	5,320	16.5	W.
" 11 " 12	24,338	5,958	17.9	N. W.

Average number of revolutions per day, 15,515.

Average number of gallons pumped per day, 3,791.

This test is conclusive proof that the conformation of the ground about the windmill location had a great deal to do with the effective working of the machine, for although this windmill was high above the immediately surrounding wind obstructions, it is seen that the wind from one point gave very little result; the same velocity from other points gave good results. Compare the record on the fifth and sixth with other days.

A location of this kind is very unusual; ordinarily a mill will average the same amount of work in the same velocity of wind, no matter from what direction it comes, but in order to ensure results, it is well to study carefully the proposed location and provide for its peculiarities. We cannot too strongly recommend erecting as high a tower as is practicable, thus placing the mill above the eddying ground currents.

10-Foot Eclipse Windmill and 2,200-Gallon Frost-Proofed Tank on 34-Foot Tower.

Erected on Estate of SAMUEL HASTINGS, Esq., Dover, Mass.

This outfit is in continuous service throughout the year, supplying water from a dug well for general domestic purposes.

The Eclipse Pumping Windmill.

The Eclipse windmill was first built in 1867, and its distinctive feature in comparison with other mills is that it was the Original Solid Wheel Self-Regulating Wind Engine. Its plan of construction and method of regulation made it an entirely distinct type of self-regulating windmill, of which the solid wheel represents more than three quarters of the windmills now made. There are practically only two types of self-regulating windmills offered for sale, and of these two classes the solid wheel variety easily takes the lead, because it combines more advantages than those using the sectional, or centrifugal, method of regulation. The solid wheel mill is one which reduces the number of its working parts to the arrangement consistent with the highest efficiency, and at the same time utilizes to best advantage the power of the wind surface in its wheel. The centrifugal regulating, or sectional, windmill is lacking in both these important particulars. For comparison of these points see chapter on "The Method of Regulation of the Eclipse Mill."

The Eclipse is the standard windmill of the world to-day, and the large number of solid wheel windmills now made claim especial merit from some of the working principles of the Eclipse, but in no other are so many valuable and important features combined as in the original solid wheel mill. Having been longer in the field than others of this type it has had the advantage of improvement in details by men of the largest and widest experience, and the present model is better fitted to meet the demands of a durable pumping machine than we have ever before offered. Its parts are thoroughly adjusted to all the varying conditions of wear and strain which the wide range of wind power involves, and its long and successful use is direct evidence that it is a machine perfectly adapted to the service for which it is intended. It has been applied to every purpose for which a windmill can be used in all quarters of the globe, and is the standard windmill adopted by the U. S. government for service at its navy yards, forts, and other institutions.

In all this wide experience, under every kind of weather conditions, with varying loads, being erected by and left in the charge of men of widely varying characteristics and training, in all climates, it has proven itself a thoroughly satisfactory and efficient windmill, and the testimony of a constantly increasing demand for our goods is evidence of the impression made upon our patrons by its use. We shall endeavor to maintain the high standard of the Eclipse in the future, and so far as improvement can be made, will take every care to keep the machine as nearly perfect in its working arrangement as it is possible to build it.

PRICE LIST OF ECLIPSE PUMPING WINDMILL.

Diameter.	Shipping Weight.	Price.
10 Feet.	510 Lbs.	$ 75.00
12 "	670 "	100.00
14 "	1,100 "	165.00

10-Foot Eclipse Windmill and 1,600-Gallon Frost-Proofed Tank.

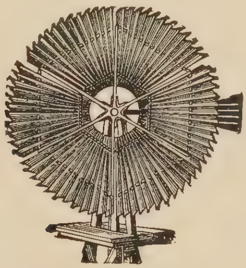
Erected on Estate of W. T. WELSH, Esq., Dover, Mass.

This Windmill draws water from a spring 500 feet distant, and 20 feet lower than the ground at base of tower.

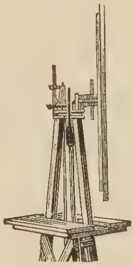
The Method in the Regulation in the Eclipse Mill.

The operation of our principle involves the use of a wind wheel, side vane and flexible rudder, so arranged as to act automatically together. Referring to cut No. 3, a front view of the mill will be seen, showing the wheel and side vane (which is attached to the same casting as the wheel), and moves it around out of the wind into a position parallel with the rudder, thus getting out of the way of, and presenting no resistance to, the wind. In this position the mill is without strain, as its operation is the same as that of a door, which, when it blows open, relieves itself of all strain by swinging away from a position facing the wind, to one in which it is edgewise to the wind. As the gale dies down the wheel is brought back into working position by the automatic action of the weight, the resistance of which increases as the rudder and the wheel approach, and decreases as they recede, thus maintaining the uniform speed of the wheel and preventing it from stopping entirely in very high winds. This is on the same principle that a gate will shut itself automatically if hung in connection with a weight.

Cut 3.



Cut 4.



The adjustment of the varying influences of this weight to the demands of a windmill regulator, is a matter which is the result of years of study and experience. We call particular attention to this feature in the Eclipse mill. The wheel is held into the wind by the weight, No. 13, on the weight bar, No. 26, shown in cut of working parts on the twenty-second page. As the pressure of a heavy wind carries the wheel out of its working position through the influence of the side vane, the weight, No. 13, and weight bar, No. 26, are raised by the gears, No. 14 and No. 19, to a horizontal position, at which point the influence of the weight, No. 13, is the greatest it can develop under normal conditions, because it is farthest from the fulcrum of the lever it acts upon. At the same time the side vane and wheel are presenting the least possible surface to the wind, making the regulating arrangement extremely well adapted to the ordinary wind changes. But this arrangement alone is not sufficient to control the windmill perfectly in very high gales, as the variations in wind velocity are extreme in severe weather, and it is just at these times that all other windmills suffer most severely from such incomplete governing arrangements as we have so far described. The improvement over all others in the Eclipse lies in the arrangement of the gears forming the fulcrum through which the

14-Foot Eclipse Windmill and 3,200-Gallon Frost-Proofed Tank, on 32-Foot Framed and Rodded Tower.

Erected on Estate of THOMAS H. JOLLIFFE, Esq., Charles River, Mass.

The well, located directly under the plant, is 200 feet deep; the cylinder is placed at a depth of 180 feet. The above supplies all the water used for the house, stable, greenhouse and gardens.

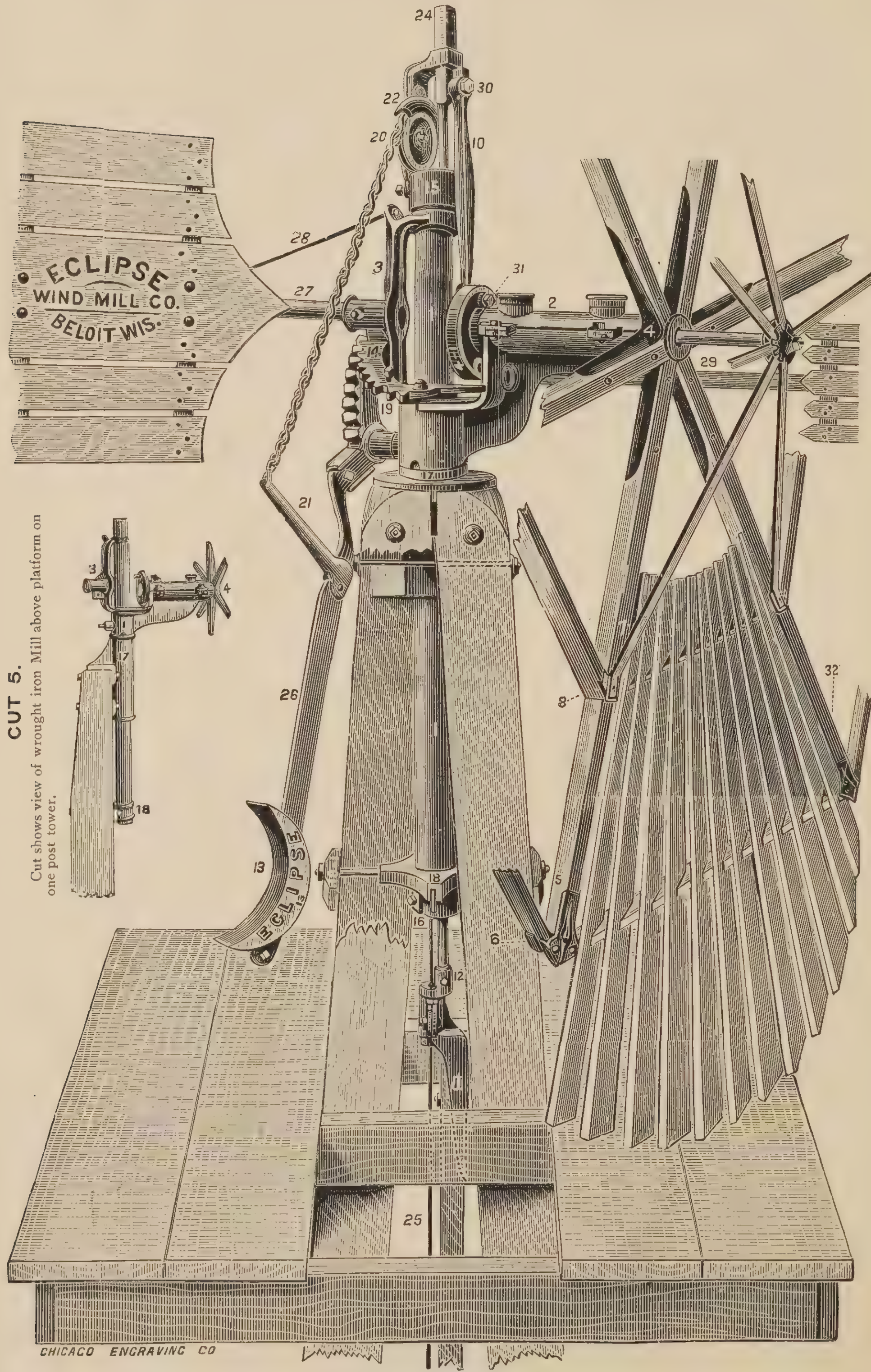
weight, No. 13, and weight bar, No. 26, exert their control over the windmill's movements. Note that the gears, No. 19 and No. 14, are built eccentric, that is, the distance from the centre of the gear to the end of the teeth decreases as the windmill wheel is swung out of the wind, thus increasing the influence of the weighted lever by shortening the length of the fulcrum it acts upon, so that it is impossible to carry the wheel out of the wind by a sudden gust so quickly as to jar the working parts and endanger them. The actual result of this combination is to make the wheel exceedingly sensitive to a dangerous wind pressure; it will recede from the wind instantly and very rapidly up to the point where further motion in this direction would cause undue strain upon the regulating parts, and it then adjusts itself to the wind easily, because of the advantages of the eccentric gear connection. This increase in the influence of the weight bar in the Eclipse over that on other mills results in an increase in its pumping capacity, because it is held to effective work in winds that are so strong as to entirely shut off insufficiently regulated windmills. This means that the wearing parts of the Eclipse must be made more durable than in other mills to provide for this extra service, details of which are fully described on the twenty-third page. The speed of the wheel or its adjustment to the work required is regulated by moving the weight, No. 13, up on the weight bar, No. 26, or by moving the side vane in toward the centre of the wheel, thus varying their leverage. This double regulation of the Eclipse windmill is one of the elements entering into the practical application of the machine to widely varying loads, that has won for it enduring praise. No other windmill combines in its mechanism a simple combination of parts, with such efficiency in governing.

Comparing Other Methods of Regulation with the Eclipse.

Other mills using side vanes have only a simple lever and weight, or a combination of levers and weights, which are designed to properly govern their speeds, but the inherent faults of a single-weighted lever, without eccentric connection, are only multiplied by these combinations. Such mills do not usually provide for any adjustment of the side vane, which limits their capacities to the light loads taken care of by their inferior governing devices. Other solid wheel windmills, which dispense with the side vane, endeavor to make a substitute for it by placing the main vane, or rudder, to one side of the centre of the wheel, thus having more of the wheel surface on one side of the vane than on the other. This makeshift involves a double loss, in that the wheel is never squarely presented to the wind when at work, and the side draft of its fans, because of this construction, consumes power that should be applied to the pump. But the vital defect in these mills is the lack of complete regulation due to a simple lever and weight alone.

The centrifugal, or sectional, wheels are faulty in principle because they must receive the whole force of the wind to enable them to get up speed so that the governor can operate, a defect which makes them subject to excessive strain and wear. They require a very complicated mechanism for their regulating device,

THE ECLIPSE PUMPING WINDMILL.



CUT 5.

Cut shows view of wrought iron Mill above platform on one post tower.

which, when worn, is entirely unreliable, and a failure in any one part, due to wear, throws upon the other parts strains for which they are not intended, resulting in damage to the windmill if not constantly cared for. Their principle of regulation necessitates the loss of wind surface in the shape of the wheel fans, so that while a 10-ft. Eclipse presents sixty-eight square feet of working surface to the wind, the 10-ft. sectional has only sixty-two. The 10-ft. Eclipse, when out of the wind, presents but three and one-half square feet to a gale, the sectional wheel showing nine and one half. In the matter of simplicity of regulating parts, the 10-ft. Eclipse has no joint in the wheel, the sectional wheel of the same size having forty-two joints to wear, rattle and break loose, the rest of the regulating mechanism in the sectional mill, outside of its wheel, being no simpler than in the Eclipse. For simplicity and efficiency the Eclipse method of regulation has been thoroughly tested and is unexcelled, combining as it does all of the advantages without including any of the defects of other windmills.

Construction of the Pumping Mill.

The general principle upon which the Eclipse windmill is made up is that of building to the best advantage, meeting all requirements and taking care that every element of value shall have its proper function in the operation of the machine. Referring to the cut, it will be seen that when the wheel is in the wind the vane and the wheel shaft are in line, so that the wheel surface is presented squarely to the wind, yielding the full power of its fans to its load. Again, when it is out of the wind, only the edge of the wheel is presented to a wind pressure, thus relieving it of all strain. The working parts of the mill are mounted upon one pivot casting, this being a combination of wrought and cast iron, making a rigid and firm support for the lighter parts. Note that the wrought-iron tube in the pivot casting, No. 1, extends down into the tower from the turntable, No. 17, to a sufficient distance to give the mill a firm bearing, preventing any rocking of the machine on the tower in heavy winds. The turntable consists of two lathe-finished surfaces, and the great length of the pivot casting in the tower makes this a very sensitive bearing in light winds. It has been adopted after using so-called frictionless balls and rollers at this point, which were abandoned because they wore flat, or uneven, in a very short time, making them worse than useless for this purpose. We gave this ball-bearing construction a most thorough test, using the best materials obtainable. We found that no balls can be made which will stand the pounding strain of the pumping stroke without wearing flat, but our present construction is durable and has never failed to give good results. Some makers still cling to the obsolete ball bearing, in direct opposition to the best judgment and experience of competent millwrights; an inexperienced customer may sometimes be led to believe that a ball bearing on a windmill is a good thing because it appears to be what it is not, and to purchase the mill on what prove to be misleading claims. The lower guide, No. 18, is adjustable, so that the windmill can be kept in line with its work at all times. The main bearing and upper guide are lined with Babbitt metal, which is the most satisfactory bearing for this purpose known to mechanics;

12-foot Eclipse Windmill, and 5,000-Gallon Frost-Proofed Tank, on 28-foot Framed and' Rodded Tower.

Erected at Estate of FRANCIS BACON, Esq., Wayland, Mass.

The Windmill pumps water from a driven well 60 ft. deep, 450 ft. distant.

it can be very cheaply replaced when worn, after years of hard usage. The wearing surfaces are all machine finished, and every mill is set up before leaving the factory. The tail gate, No. 3, supporting the main vane, is heavy and strong and has wide finished surfaces where it swings on the pivot casting. The vane and side vane bars are wrought-iron tubes, instead of decaying wood used on other mills, and are the strongest possible shape for their requirements. The vane bar is trussed in all directions to meet its strains, thus permitting the use of an extra long and large vane, which guides the wheel perfectly.

The pitman, No. 10, is made of rock maple; this is more durable than metal in this place, because it will stand more abuse and neglect. We have tried metal pitmans of various kinds and find the above much superior. The weight bar is made of wrought iron, strongly braced. The swivel, No. 11, is machine finished, perfectly adapted to its purpose, being a decided improvement on the ball and socket joints used on other mills. The iron work of the Eclipse windmill is from thirty to fifty per cent. heavier than others offered in this market.

The wooden parts of the mill are designed to resist the weather and maintain their shape under the strains brought upon them. The vane and side vane are thoroughly built, and are held in their positions on the mill in a substantial manner.

The wheel is built as strongly as it is possible to put wood and iron together; the spider, or hub, casting having long, deep sockets to receive the arms, the braces from the end of the wheel shaft forming a truss with the arms. These braces are much heavier than are commonly used; on a 10-ft. Eclipse they are one inch wide by one-quarter inch thick, while other manufacturers are using three-eighths inch rods. The girts supporting the fans, or wheel slats, are short, thick ribs, having width sufficient to allow the slats to be deeply received in the slots cut for that purpose, thus holding them in perfect alignment. The slats in the Eclipse wheel are wider and present more wind surface than in any other solid wheel mill. The castings fastening the girts to the wheel arms enclose the joints and are recessed deeper than would seem necessary; this is to hold the woodwork firmly, and to provide for the bolts passing through the wood and locking the whole firmly together. When thus put together the sections cannot be blown out by the wind.

Such construction ensures a long life to the wheel, because the jarring, pounding strain of a pump is fully provided for, the wheel is solid, having no loose joints, the straight girts take this pounding strain in the line of their greatest strength, thoroughly bracing the wheel. Other mills using bent girts in their wheel, because they are cheaper and their narrower wheel slats can be easily supported therein, lose the advantage of this braced girt, the result of the pumping strain being the springing of the bent girts and the loosening of the wheel slats, and their premature loss. The Eclipse windmill is, in design and construction, the result of thorough and painstaking work.

12-foot Eclipse Windmill on 36-foot Spiked Tower.

Erected for the TALBOT DYE AND CHEMICAL WORKS, North Billerica, Mass.

This Windmill was erected in 1877, and has been in continuous service since that time, supplying the water used in these works.

Comparative Merits of the Steel and Wooden Windmills.

Within a few years past there has been introduced to the trade the steel windmill, in which the fans and vane are made of sheet steel, and by means of extensive advertising, and other methods, the general public is informed that the steel windmill is far superior to those made of wood. The prospective purchaser is advised, on the other hand, to use only a wooden wheel, and between the arguments for both types of windmills he is sometimes at a loss to know how to decide which is really the best. We will endeavor here to show clearly the facts which present themselves to an expert, in comparing these mills. Taking up the steel windmill, first we note that the use of sheet steel involves the use of wide wheel fans, because if made narrow, like the wooden fans, they would not have sufficient strength, and if made heavy enough to be strong in a narrow width, the whole weight of the machine would make its use impracticable for a windmill, and its cost would prohibit its general use. The use of a light weight of sheet metal enables the builder to get out a very low-priced machine, seeming to combine many advantages. The great width of the fans in a steel wheel necessitates placing them at a comparatively flat angle to the wind, in order to reduce the displacement of the wheel in its rotation, such displacement having, of course, a retarding influence on its movements. This flattening of the sail angle to the wind, results in the speed of the steel wheel being accelerated when compared with the speed of a wheel having narrower fans and presenting a sharper sail angle to the wind, on the well-known turbine principle that a flat or obtuse angle gives a high speed at a consequent loss of power, while a sharp or acute angle gives a slow speed with the greatest power, from wind pressure. In other words, speed is obtained at the expense of power; there seems to be a good deal of confusion in regard to this point. Having a certain power or force in the velocity of the wind at a given moment, the problem is to apply this power to the work in the most effective manner. It is obvious that neither a broad fan nor a narrow fan windmill can produce more power from the wind than is actually there, but the results in actual work done will show conclusively the real power value of the two methods of construction. The great velocity of the steel wheel must be reduced, as the valves of a windmill pump are not designed to be operated at a high speed, and would soon become worthless if so used. To accommodate the speed of the wheel to this requirement, a set of gears is connected between the wheel shaft and the pump rod, so that the best results are obtained by making the wheel move two and one-half to three and one-half times as fast as the pump. This enables the windmill to run the pump on a somewhat longer stroke than is usual with a wooden wheel of the same size. The wooden wheel is connected to the pump so as to move the pump plunger as fast as the wheel revolves, or the plunger makes a complete pumping stroke for every revolution of the wheel. The governing arrangement of the two types of mills being similar, it remains now to compare their durability and performance.

12-foot Eclipse Junior Windmill and 3,200-Gallon Frost-Proofed Tank on 35-Foot Framed and Rodded Tower.

Erected at GLENWOOD CEMETERY, Everett, Mass.

This Windmill pumps water from a driven well 50 ft. deep, supplying water used at the cemetery.

First, as to durability of the fans and vanes, these parts being exposed to the weather wear only : — It has been found necessary to galvanize the sheet metal to protect it, as painting does not prevent rust. The experience with galvanizing has not had time to show conclusive results, but the present indications are that but little better service may be expected than from paint. The sheet metal bends more or less in heavy winds, resulting in a loosening of the galvanizing coating, leaving the iron to be rusted by the dampness of the air. Particularly is this dampness destructive on the sea coast and in low, marshy places. The wooden wheel and vane have stood the weather exposure perfectly, since their coating of paint permeates the fibre of the wood, and there are wooden mills in use to-day that have been exposed to weather for fifteen years without having been painted since they were first erected. There are others that have been painted regularly at intervals of about three years that have been in use twenty-five years, to which we will refer on application. As to the durability of the working parts :—The steel windmills move their wheel shaft very much faster and their pump shaft somewhat more slowly than the wooden mills, and have a much more complicated mechanism because of the intermediate gears to reduce the speed of the machine. The high speed of the wheel shaft makes it necessary to oil this bearing much oftener than the other parts, and the friction of the gears involves wear that cannot well be avoided. The damage, due to neglect, to high-speed bearings is much more serious than to a low-speed bearing carrying a much heavier load, and it is in the neglect of the working parts that the steel windmill is most likely to be injured, and the experience of the last five years goes to show that their working parts are necessarily of very short life. So serious a matter has this become in some of the steel windmills of crude design, that it has been deemed advisable to use a graphite bearing, for which is claimed great durability, and absolutely no attention whatever, not even oiling: we have never seen one of these windmills that did not require oiling when in actual service. Our own steel mill is provided with Babbitt metal bearings, fitted with proper facilities for oiling.

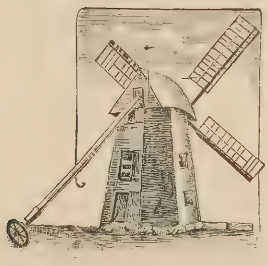
In a wooden windmill the working parts move slowly, and are much heavier in proportion to their load than in the steel mills, the strains are more evenly distributed, and there is no one bearing requiring more attention than another, the experience of years enabling this adjustment to be made to the best advantage, and it has never been found necessary to provide self-oiling makeshifts for a properly constructed wooden windmill. The secret of the great durability of a wooden windmill's mechanism is due to its slow movement, the very slight wear being the natural result to be expected from machinery proportioned to its requirements on the best mechanical principles. As to actual pumping capacity, there is a wide difference in the claims made, but the facts can be deduced from the following observations : — A 12-foot diameter Eclipse mill, in three revolutions, moves its pump piston thirty-six inches, and a 12-foot steel wheel, in the same number of turns, sixteen inches. In actual practice the same diameter of plunger is used, but the steel windmill has a stroke of eight inches, while the wooden mill uses only a six-inch stroke. The claim is made for the steel mill that they will operate larger pumps than the same diameter of a wooden mill, but in practice this is never done. Taking, then, the above statement of the movement of the pump piston, the steel windmill must

10-Foot Eclipse Junior Windmill on 50-Foot Spiked Tower.

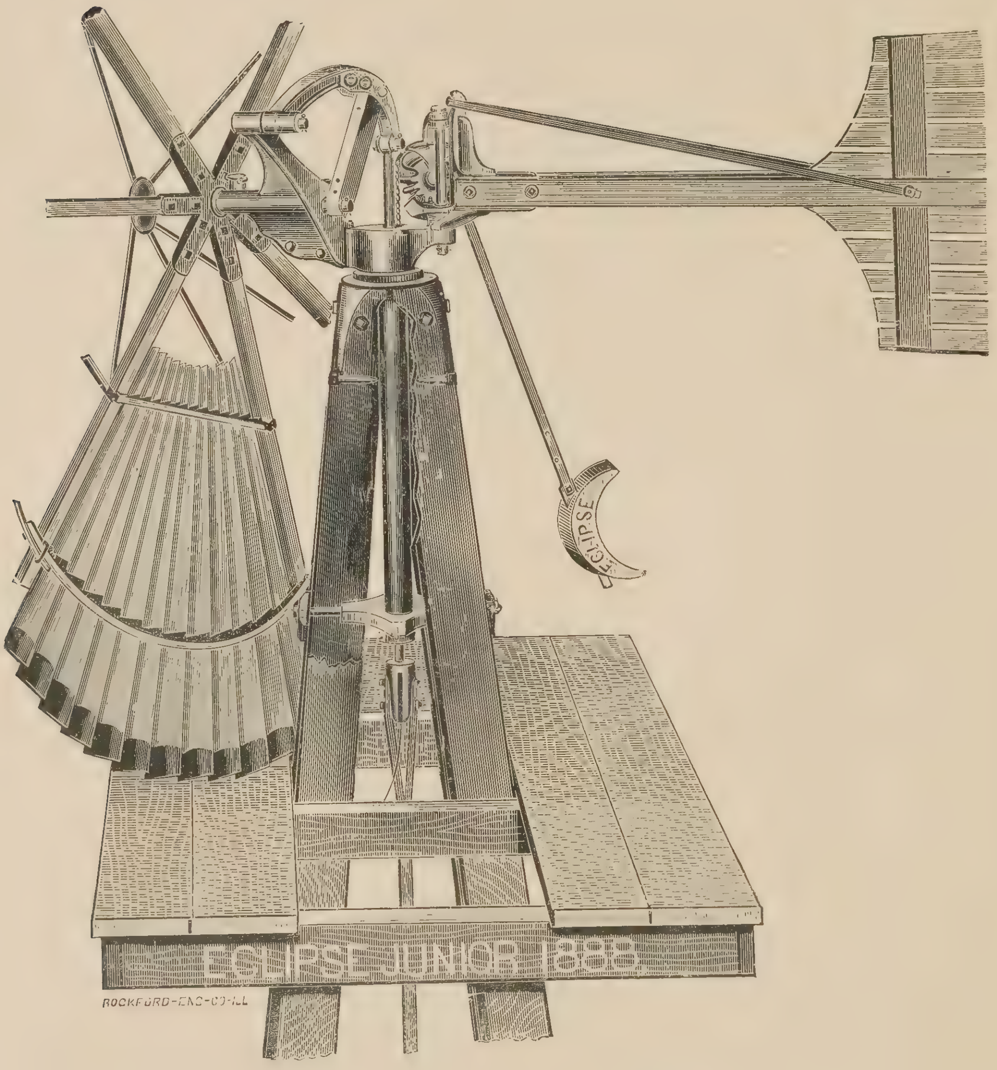
Erected on the Estate of C. H. TOWLE, Esq., Revere, Mass.

This Mill pumps water from a well 26 ft. deep, into a frost-proofed tank located in loft of barn.

revolve six and three-fourths times as fast as the wooden wheel to do the same work. This is impossible, for several reasons, the first of which is, that only in very high winds, such as are dangerous for a windmill, can these speeds be attained ; then there is not so much wheel surface in a steel windmill as in a wooden wheel, and its value for power does not begin to compare with that of a wooden wheel, because of the flat angle of its sails. The speed and power of a windmill wheel are determined entirely by the angle and width of its sails, and in the Eclipse the combination is the result of exhaustive research and experiment, yielding maximum results. There is one claim made for the steel wheel that is most deceptive to the novice : — this is, the fact that it will run in a lighter wind than a wooden wheel. This is true, and we call particular attention to the fact that the pump piston cannot be packed so tight as to pump water when moving slowly, without causing very great wear on the cylinder, and consuming great power, because of the friction. A pump connected to a steel mill, running in a wind so light that a wooden mill will not move, is of course being moved one third as fast as its windmill wheel runs, a speed so slow as to preclude the possibility of pumping any water, simply because the pump plunger would have to be packed so tight to throw water at this slow speed that the friction would consume the whole power of the wheel in this light air, and if loose enough to be moved in this light breeze, it is too loose to pump. Right here is the important point: the wooden mill moves its pump piston fast enough to throw some water until the wind velocity ceases to yield power enough for pumping, the steel mill keeps on turning idly and serves no useful purpose, wearing its parts needlessly, appearing to do what it does not. Taken altogether, experience and observation show conclusively that the wooden windmill is more durable and efficient than the steel windmill as now made.



The Eclipse Junior Windmill.



PRICE LIST. ECLIPSE JUNIOR MILLS.

Diameter.	Shipping Weight.	Price.
6 Feet.	200 Lbs.	$25.00
8½ "	280 "	35.00
10 "	400 "	45.00
12 "	600 "	60.00

The Eclipse Junior is introduced to meet the demand for a durable and efficient windmill, of less expensive construction than the Eclipse, built in such a manner as to insure satisfactory results at a minimum cost. We call attention to some valuable features of its makeup.

It is a strongly built machine, and its mechanism is so arranged as to utilize the power of the wheel in the most efficient manner.

All wearing parts of the mill are so fitted that they are readily put together and taken apart, making the machine one that can be erected by any mechanic without special tools, and when worn, these parts can be easily replaced without disturbing such pieces as are not subject to wear.

The power of the wheel is applied in a direct line through the vertical centre of the mill to the pump, thus avoiding the shock and vibrating strain to the pump rod, incident to all mills using an offset in the pump connection.

Provision is made for both long and short strokes; it is thus equally adapted to either deep or shallow wells.

Its construction is simple; there are fewer wearing parts in this mill than others; all these parts are provided with long and large bearings, which insure safe and economical wear.

The woodwork is unexcelled in quality by any excepting the Eclipse, the wheel and braces being the same.

The bar carrying the governing weight is of iron, instead of wood as in many other makes; note the geared connection between the weight bar and vane, making the best possible arrangement for this purpose.

The pole-connection swivel is adjustable to wear, and can be kept in perfect working condition.

The turntable and guide at the head of the tower are the same in this mill as in the Eclipse, insuring freedom of movement, and perfect regulation at all times.

The vane is provided with our adjustable wrought-iron brace, which properly supports the same and prevents the sagging tendency so often seen.

This windmill is particularly adapted to the wants of small farms and market gardeners, and we recommend it as a reliable machine.

16-Foot Eclipse Windmill on 100-Foot Tower.

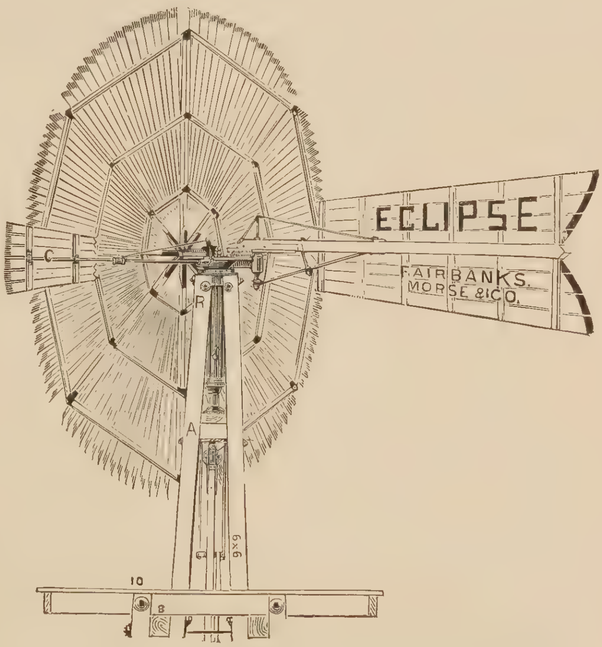
Erected on Estate of Hon. ROBERT TREAT PAINE, Waltham, Mass.

This Mill operates a 4 x 8 double-acting Eclipse pump, figure 50, drawing water from three 50-foot driven wells, and forcing it into a 30,000-gallon frost-proofed tank.

THE ECLIPSE RAILROAD PUMPING WINDMILL.

Railroad companies require the most severe and exacting service of windmills, as they must have a reliable supply of water; those we make to meet this demand are heavily constructed, and are designed to stand hard and continuous service without serious wear. The demands of public institutions, small towns, and isolated communities for a water-supply system that will be of practically no expense for maintenance, are fully met by the use of our larger sizes of windmills in connection with a suitable service for storage.

The cut on this page gives a quartering view of the Railroad Pumping Windmill, showing its construction and general arrangement, and the substantial manner in which it is mounted on the tower; it also shows the position of the main and side vanes, relative to the wheel when it is in the wind.



Note that the parts are mounted upon the heavy main or pivot casting, resting upon a hardened steel step at A, and held in line by the cap plate on top of posts. This construction keeps the working parts in perfect line, because they are all supported on one casting.

The wheel is solidly built, having short, straight ribs to support the fans, its arms are thoroughly braced, and all joints are enclosed in castings, which are bolted together; thus it is capable of running at a high rate of speed without injury. The main and side vane bars are very strongly trussed, and all parts are designed to provide for any strain that may be brought upon them. Its working parts are adjustable to wear, and can be easily replaced, but if cared for they will remain in perfect working order through many years of hard usage.

Sectional Wheels regulating on the Centrifugal Principle, turning the sails on pivots to or from the wind, have 90 to 100 joints in the Wheel alone. These are constantly working, wearing, and becoming loose. A high speed cannot be obtained, as it would tear the Wheel to pieces. A few years of wear makes them noisy and unsightly. Their regulation is not as perfect as that of the Eclipse.

PRICE LIST OF THE ECLIPSE RAILROAD PUMPING WINDMILLS.

Diameter.	Shipping Weight.	Length of Stroke.	Price.
16 Feet.	1,650 Lbs.	6 and 8 Inches.	$280.00
18 "	1,875 "	6 " 8 "	325.00
20 "	2,835 "	7, 8 " 10 "	450.00
25 "	5,000 "	12, 14 " 16 "	625.00
30 "	8,500 "	12, 14 " 16 "	900.00

30-Foot Eclipse Windmill on 100-Foot Framed and Rodded Tower.

Erected at Cambridge, Mass., for E. D. BROOKS, Esq.

This Mill pumps water from an Artesian well 280 feet deep, into storage tanks located on building 80 feet above street level, for tenement-house supply.

TABLE OF DIFFERENCE IN A 22-FOOT ECLIPSE AND A 22-FOOT SECTIONAL WHEEL WINDMILL.

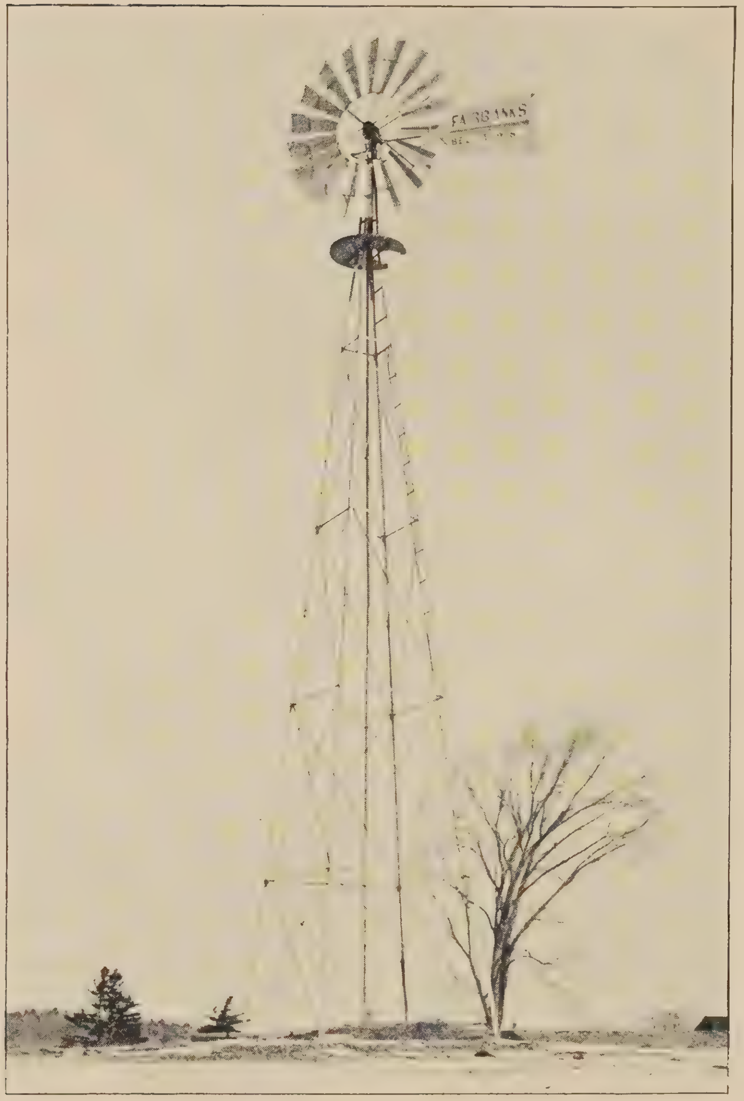
	Eclipse Mill.	Section Mill.
Wind-receiving and working surface in wind	352 Sq. Ft.	308 Sq. Ft.
Wind-resisting surface presented when out of wind	9½ "	48 "
Revolutions per minute wheel can safely run	50 "	25 "
Total number of pivots and joints in wheel	None.	92 "

Partial List of Railroad Companies Using the Eclipse Railroad Windmill.

Anniston & Cincinnati.
Atchison & Nebraska.
Atchison, Topeka & Santa Fe.
Baltimore & Ohio, Potomac Branch.
Boston & Maine.
Burlington, Cedar Rapids & Northern.
Burlington & Missouri River.
Burlington & Western.
Canadian Pacific.
Central Branch of Union Pacific.
Central Vermont.
Chattaroi.
Chicago & Northwestern.
Chicago, Milwaukee & St. Paul.
Chicago, Burlington & Quincy.
Chicago & Eastern Illinois.
Chicago, Rock Island & Pacific.
Chicago, St. Paul, Minn. & Omaha.
Chicago & Paducah.
Chicago, Pekin & Southwestern.
Chicago & West Michigan.
Cincinnati & Hocking Valley.
Cincinnati, Wabash & Michigan.
Columbus & Hocking Valley.
Central Iowa Railway.
Denver & South Park.
Des Moines & Fort Dodge.
Des Moines, Osceola & Southern.
Detroit, Lansing & Northern.
Dubuque & Dakota.
East Line.
Flint & Pere Marquette.
Fort Scott, Southeastern & Memphis.
Fremont, Elkhorn & Missouri Valley.
Galveston, Harrisburg & San Antonio.
Green Bay & Minnesota.
Gulf, West Texas & Pacific.
Houston & Texas Central.
Humeston & Shenandoah.
Illinois Central.
Iowa Central & Northwestern.
Kansas City, Fort Scott & Gulf.
Kansas Pacific.
Keokuk & St. Louis.
Louisiana Western.
Louisville, Cincinnati & Lexington.
Louisville, New Albany & St. Louis.
Maine Central.
Minneapolis & St. Louis.
Missouri, Kansas & Texas.
Newport & Wickford.
New York, New Haven & Hartford.
Northern Pacific.
Oregon Ry. & Navigation Co.
Owensboro & Nashville.
Paris & Decatur.
Peoria & Farmington.
Pittsburgh, Cincinnati & St. Louis.
Port Huron & Northwestern.
Rich Hill.
St. Paul, Minneapolis & Manitoba.
St. Paul & Duluth.
St. Louis, Hannibal & Keokuk.
St. Louis & San Francisco.
Southern Pacific.
Southern Kansas.
Union Pacific.
Wheeling & Lake Erie.

Some Public Institutions and Corporations using the Eclipse Railroad Windmill.

Winchester Water Works, Winchester, Mass.
Mass. State Almshouse, Tewksbury, Mass.
Dedham Town Farm, Dedham, Mass.
Andover Theological Seminary, Andover, Mass.
Baptist Theological Seminary, Andover, Mass.
D. L. Moody's Boys' School, Northfield, Mass.
Hillsborough County Farm, Wilton, N. H.
Manchester City Farm, Manchester, N. H.
Manchester Street Railway, Manchester, N. H.
Belknap County Farm, Laconia, N. H.
Strafford County Farm, Dover, N. H.
Consolidated Light and Power Co., Dover, N. H.
U. S. Navy Yard, Portsmouth, N. H.
Maine Agricultural College, Orono, Me.
Sanford Light and Power Company, Sanford, Me.
U. S. Naval Station, Newport, R. I.
State Board of Charities, Howard, R. I.
Manhansett Improvement Co., Shelter Island, N. Y.



8-Foot Fairbanks Galvanized Steel Windmill on 40-Foot Galvanized Steel Tower.

Erected on Estate of JOHN B. ANTHONY, Esq., City Mills, Mass.

Supplying water for stock farm and residence.

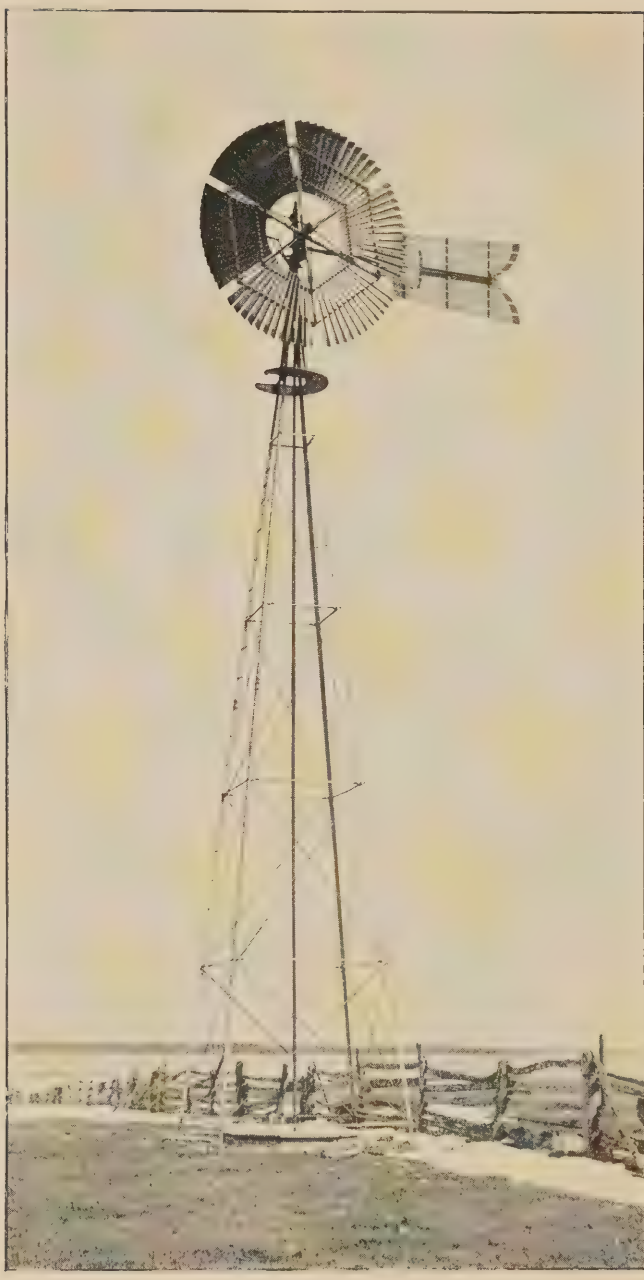
THE FAIRBANKS STEEL WINDMILL.

Our steel windmills are made under the supervision of the builders of the Eclipse, and nothing has been left undone to make them as perfect as is possible in every part. In the arrangement of working parts and in the principle of regulation it has been our care to make the most of the capabilities of this form of windmill construction.

Price: 8-Foot Galvanized Mill, $30.00.

Our experience with this machine in widely varying tests, gives us entire confidence in its superior qualities as a durable and efficient steel windmill. The wheel fans are made of sheet steel, rolled on a special curve to give them strength, and the outer ends are corrugated; that is, it has a strengthening rib, rolled in the metal, giving an additional stiffness possessed by no other steel wheel. The arms are flat steel, so shaped as to brace each other, and they are longer than those used in other mills of this type; this carries the outer rim, supporting the fans, well out from the centre of the wheel, making the projecting end of the fan shorter and consequently stiffer, than in other makes.

The vane is very strongly built of steel, corrugated on its edges, and, having cross-braces over its whole width, is not likely to be twisted or warped out of shape in heavy winds. It is very long and wide, having complete control of the movement of the mill on its turntable. The vane bar is a galvanized wrought-



10-Foot Eclipse Windmill on 40-Foot Galvanized Steel Tower.

Erected on stock farm of CHAS. A. KING, Esq., Mattapoisett, Mass.

Supplying all the water used for farming and dairy purposes.

iron tube, one inch in diameter, which is further supported with a three-quarter inch brace of the same material. We know of no stronger vane on any steel mill in the market.

The mill is governed by a lever and weight, in conjunction with a spring which serves as a buffer to relieve the mill from shock or jar in heavy winds. This spring is adjustable and the weight can be shifted on its bar, so that the mill will pump in heavy as well as in light winds. We have never known the regulating device on this mill to fail in any particular.

The bearings of this mill are long and heavy and are lined with Babbitt metal which can be easily renewed when worn. Graphite bearings will be furnished, if ordered, but their use is not recommended.

The working parts are strong and well proportioned, heavy where strength is required, and light where it is possible to use such without impairing the durability of the machine. These mills are designed to move quickly and with as little friction as possible. Many offered in this market are of crude design, their working parts are out of proportion to their loads, in some details having a clumsy overweight and in others a lack of material. The mechanical details of the construction of the Fairbanks are such as to commend themselves to competent judges.

Particular attention is called to the fact that the wheel revolves on a stationary shaft, making this bearing a self oiler; the wheel hub has a space on the inside between the bearings which forms a reservoir that can be filled with oil, and as the hub turns on the shaft this oil is automatically distributed to the bearings; these are usually the most severely taxed of any on the mill. We know of no more practical oiling arrangement than this for the purpose. The pitman and pump rod are connected with a rocker arm in such a manner as to make the lift a direct one on the pump plunger, thus avoiding all side draft and loss of power from complicated guides and connecting rods. The work of pumping is done on the up stroke, and the rocker arm connection distributes this load over nearly two thirds of the revolution of the crank-pin, making the mill run very evenly. This enables us to gear the mill so that the wheel turns only two and one-half times to one stroke of the pump, resulting in the greatest average movement of the pump plunger in a given velocity of wind. We galvanize all our mills after they are built, thus protecting them from the weather much more effectually than it is possible to do with paint. All parts are interchangeable, and can be replaced by any mechanic without difficulty. We have noticed that steel mills are usually built so that repairs are difficult to make, and if one part is worn it is often necessary to buy a large part of the machine to repair it; this is a feature that has been carefully guarded against in the Fairbanks, and will be appreciated by a customer.

12-Foot Eclipse Windmill and 2,200-Gallon Frost-Proofed Tank on 30-Foot Enclosed Tower.

Erected on Estate of CHARLES L. HILDRETH, Esq., Westford, Mass.

This Mill pumps water from an Artesian well 98 feet deep, supplying the buildings and grounds.

Towers for Windmills.

Unlike most other machinery, the windmill is not ready for operation when sold. A most important feature of its arrangement is yet to be provided before it is ready for use. It must be erected on a substantial and properly constructed tower. At least three things enter into the question of the proper erection of a windmill tower, of which the first is a sufficient amount of material. Nothing is poorer economy than to cut the bill of lumber for the tower down so low as to make it insufficient for supporting the mill : by supporting the mill we do not mean its strength to hold the mill up against storms, but its ability to hold firmly against the strain and concussion produced by the working of the pump. It should be borne in mind that every revolution of the crank shaft throws the whole weight of the pumping strain onto the windmill tower, and this strain is the nature of a "hammer stroke," producing concussion and jar. A mill, therefore, that is insufficiently supported by a tower will, under the continued "pumping pound" produced by its working, severely strain and wear its parts.

A customer who goes to the expense of getting a good mill should not begrudge the last few dollars that would be necessary to insure his mill against the injurious effects of a weak and shaky tower. For the same reason it is important that the tower be put together according to proper rules. The lumber schedule may provide abundant material, but if that material is not placed where it will do the most good, the tower will be inadequate.

One of the general rules to be observed in the erection of the tower, is that its truss braces should begin with the tops of the anchor posts, and thus relieve the corner posts of the tower from excessive strain and jar, which would otherwise be brought upon them at that point.

The truss braces should be made the same on all sides of the tower. Many, in order to economize material, will cross-lath one side of the tower in order to make it serve the double function of a ladder and bracing of the tower. This makes one side of the tower weak, which will inevitably cause it to warp out of plumb and in the direction of its weak points. The ladder should be a separate thing from the tower braces, and should continue on the outside of the tower from top to bottom. Other features might be mentioned as entering into a properly constructed tower, but the most important consideration is that the tower should be plumb, and be so located over the pump that the pumping strain of the mill shall be down the central line of the tower. This implies, of course, that the tower shall be properly framed, properly put together, properly located, and when all is finished, shall stand square and plumb with itself and with all its work.

Here we would answer, in passing, an incidental question often asked by our customers: "Should a windmill tower be painted when erected?" This question we almost uniformly answer in the negative. Most tower stuff is more or less green when put together: any paint that would be of value if put on at once, would shut in the sappy acids so as to produce a dry rot that would eat out the strength of the timber.

Our recommendation is, that the tower should be painted from three to six months after it is erected, and then treated with a good priming coat of lead and oil.

Another important element in a suitable tower is, that it shall be high enough to lift the windmill to where the wind shall act freely and unobstructedly upon it. The obstructions, therefore, near the proposed location of the mill, will determine its height. If the site is clear and unobstructed by surrounding buildings, trees, etc, the tower need be comparatively low. If such obstructions do exist, the mill must be lifted above them by a correspondingly high tower, which will give the wheel the full and uninterrupted force of the wind. This is where a very common mistake is made. The great bulk of the windmill towers are built too low: many are put up in such a way that the mill is shut off from the wind on one or two or even on all sides. Mills under such circumstances are inoperative. They are also in danger, for when storms arise, they form by their surroundings the centre for whirlwinds and squalls, which are disastrous to them. In exposed places the windmills are put too low; it is usually assumed that if there are no obstructions, the lower the position, the steadier the wind, and hence the safer the machine; but the very opposite is the case. The movement of the wind near the ground is of an undulating, eddying character, and does not become uniform or steady for some distance above the ground.

Our own recommendation is that windmill towers should rarely be less than thirty-six feet high.

Wooden Towers.

The least expensive and most common towers used are what are termed "spiked" towers; these we ship with all posts and braces cut and fitted to the proper dimensions, ready to be nailed together, as shown on opposite page. These we build ordinarily of spruce or southern pine, planed on four sides, the latter being the most serviceable, but the spruce tower is as often used as the southern or hard pine. Anchor posts should be of a suitable material for the purpose, red cedar, locust, oak, chestnut and hard pine being available, red cedar being usually considered the most serviceable. With a properly framed tower there should be no hesitancy in adopting a wooden anchor post, as these can be very readily replaced if premature decay sets in, without disturbing the tower and windmill. The prices for towers, as given below, do not include anchor posts, as these are usually furnished by local dealers in lumber, but we can provide for the same at cost if desired. We can furnish towers of any height, but the standard sizes are listed below, and are suitable for mills twelve feet or less in diameter.

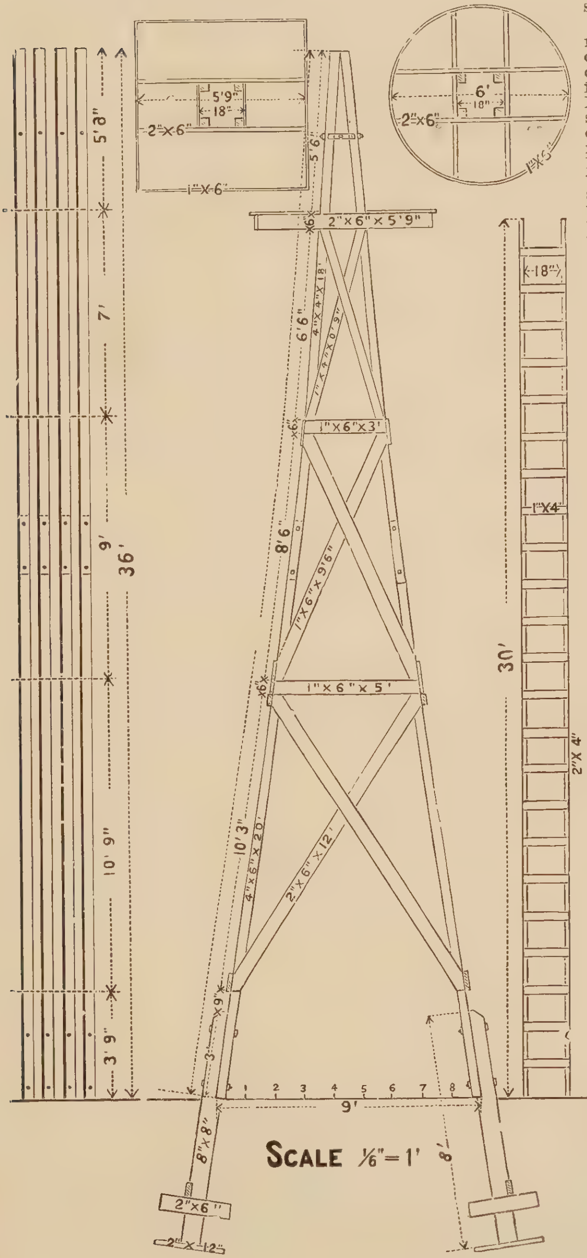
PRICE LIST OF WOODEN TOWERS.

	Spruce.	Southern or Hard Pine.
36 ft. high	$28.00	$39.00
40 " "	32.00	45.00
46 " "	36.00	50.00
50 " "	42.00	58.00
60 " "	48.00	66.00
65 " "	54.00	75.00

The above prices include all necessary nails and bolts.

Directions for Building.

36-Ft. Spiked Tower for 10-Ft. Mill.



First.—Splice the Corner Posts, lay them side by side, and square them off to length, as shown in left hand side of cut.

Second.—Space off the Posts for the Braces, marking square across the four sticks at once, according to the distance given in the cut. The first mark (5 feet from top of Sticks) is for top edge of Platform Sill, and for 10-ft. Mill (12-ft. Mill, see changes required); the second and third marks are for the top edges of the horizontal Girths. The fourth mark is for the lower point of first Brace or Cross. In building any height of Tower always bring this first brace to within 4 feet of the ground, and always put the Platform Sill at the distance from the top here given; the intermediate Crosses can be varied according to the height of Tower. After spacing off, chamfer off that corner of each post which is to come on the inside. This is done so that the timbers will fit into the thimble sockets. (See end view of Tower at the top of cut.) Lay out two of the sticks in the form of the A. Set the Tower thimble, No. 17, at the top, as shown in directions for Mill. Spike on the Platform Sill, 5 feet down from the top, make the distance across at top of platform seventeen inches, outside to outside.

Third.—Spread the bottom of the A nine feet for a 36-ft. Tower, and nail a temporary stay lath to hold it in place. The rule for the bottom spread in all towers is one fourth the height. Tack on the girths, bringing the upper edge to the marks as before stated, use each of these Girths as a pattern to cut the other three by, two of which should be cut two inches longer than pattern to allow for lapping over the ends of the other two. Cut the diagonal braces, using the first as a pattern to cut the other seven by, which belong in the same section of the Tower as a pattern. On four of the diagonal Braces of each set allow an extra inch to lap over the ends of the other four to cover the joints. To get length of diagonal Braces measure across between the horizontal Girths diagonally from one corner to the other, and rack the corner posts until the distance from one corner to the other each way are equal. Then scribe on diagonal Brace, using the first cut as a pattern for the other seven, allowing an extra inch on the end of four Braces, top and bottom in each section, for lap to cover up the joints on the other four.

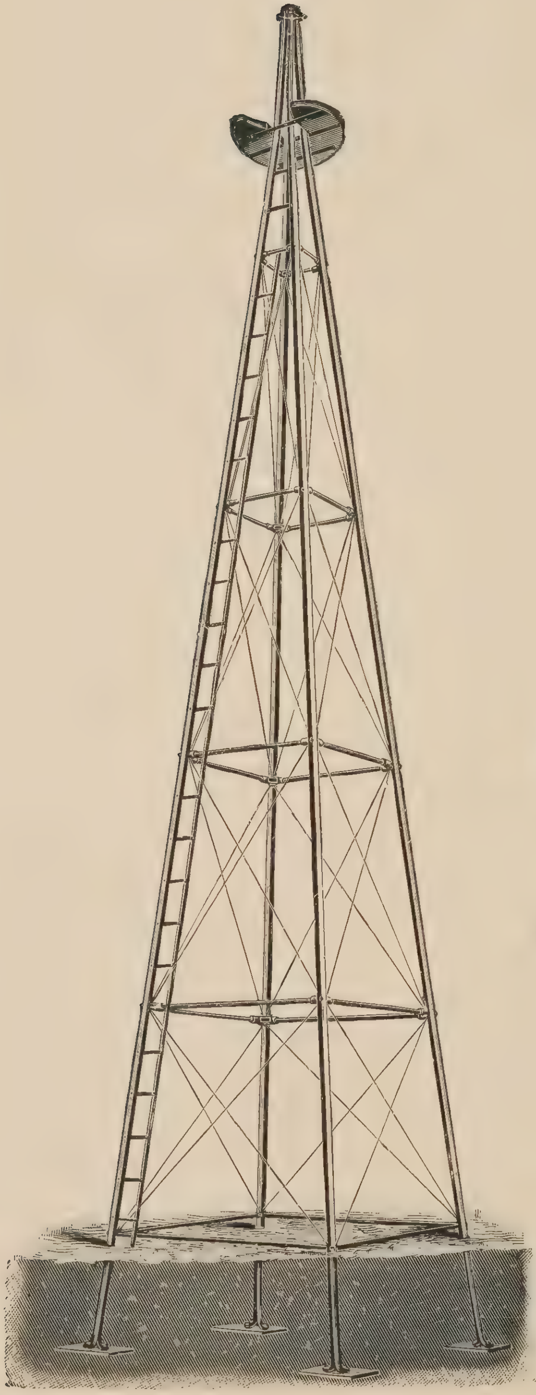
Proceed in the same manner with each section in the Tower, observing the following rule: that the diagonal Braces should all be of uniform length and cut, with the exception of those on which allowance has been made for lap. The two braces which form the cross on each of the four sides of the Tower should be exactly alike, and the Tower posts racked out or in to accommodate the joint.

When the two "A's" of the Tower are completed, turn them up edgewise with Braces outside, and chamfer end for Tower thimble on the inside. Put in four bolts around the Thimble, No. 17, draw the four posts snug together and proceed to put the other two sets of Braces and Girts on. Finish the Platform as shown in cut, and raise the Tower up bodily by pulleys and ropes. Before anchoring, level the Tower with a spirit level on the lower Girts. The Anchor-posts should be at least eight inches through at the bottom and go into the ground at least five feet, and have a cross-piece on bottom, so Tower cannot pull up or sink down. Never drive in the Anchor-posts, but dig holes and set them down level. After building the ladder as shown in the cut, nail it to side of Tower most convenient. Put the Mill together as shown in directions for mill.

Change in Tower for 12-Ft. Mill.

Place Thimble, No. 17, in its place, preparing the Tower same as in 10-ft. Mill, only make Platform 6 feet down from tops of Posts, and have the Posts 20 inches outside to outside at Platform, and 4 x 6 for Bottom Posts are generally used.

Fairbanks Steel Towers.

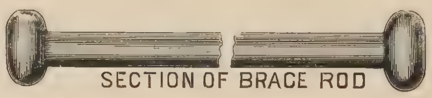


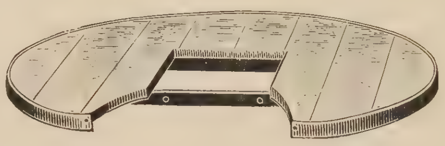
PRICE LIST OF STEEL TOWERS.

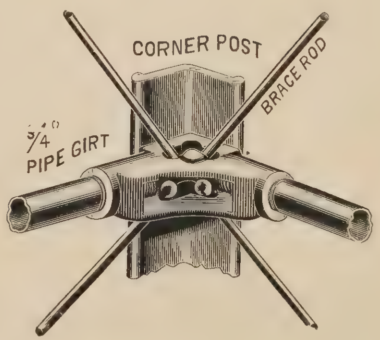
	HEIGHT.	SHIPPING WEIGHT.	PRICE.
Painted.	30 ft.	500 lbs.	$25.00
	35 "	590 "	30.50
	40 "	700 "	36.00
	50 "	930 "	45 50
	60 "	1220 "	60.00
Galvanized.	30 ft.	520 lbs.	$33.50
	35 "	600 "	38.00
	40 "	720 "	43.50
	50 "	970 "	59.00
	60 "	1270 "	74.00

These prices include GALVANIZED ANCHOR POSTS for either painted or galvanized Towers.

BRACING OF SECTIONS.







These towers up to forty-six feet in height have four inches by four inches corner posts; above forty-six feet, four inches by six inches lower posts, and four inches by four inches upper.

For the larger sizes of windmills we recommend what is known as a "framed and rodded tower," which is much stronger than a spiked tower; the braces are fitted and framed into the posts and the whole structure is bound together with iron rods in a very substantial manner. The corner posts usually rest on piers of brick or stone, to which they are anchored with iron rods; the cost of these towers varies with the details of the outfit, according to the size of the mill used, etc., and we will be pleased to furnish prices on same on application.

For illustrations of framed and rodded tower, see pages eight and thirty-six; also see towers for general mills, later.

Steel Towers for Windmills.

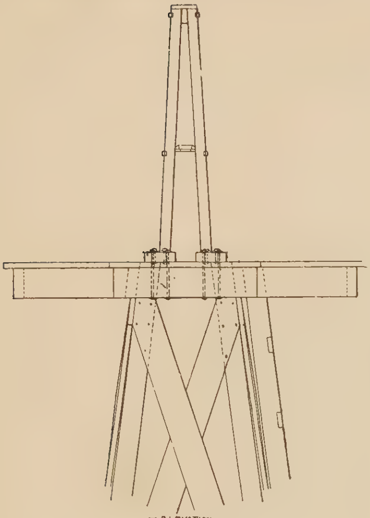
Referring to cut of our Fairbanks steel tower for 8 and 10-foot mills on opposite page, we direct attention to the fact that it has four corner posts, making a stronger arrangement than a tripod can be. It is built of best quality of angle steel, and has a strong and safe ladder, which is conveniently placed for access to the platform, and is far superior to the dangerous hooks or steps attached to one corner of the tower, which are so placed as to make it a risky operation to ascend the tower and climb over the edge of the platform to get to the mill. With our ladder and properly built platform, there is absolutely no danger from insecure footing, and the platform is bound with iron, making it very secure. The construction of this tower is such as to insure its long life, because it is properly put together. The tubular girts are stronger than a channel or an angle iron girt, and in the design of our braces we are far in advance of the ordinary construction. We use one-quarter, five-sixteenth, and three-eighth inch rods for braces, having a bulb of solid metal on both ends, which hook into the castings receiving the girts. The ordinary method of making the braces is to cut threads on their ends with nuts attaching them to the corner posts. These threads on such small rods cut away a large proportion of the metal, and they are sure to rust in a very short time, as they cannot be galvanized, making the tower unsafe. We cut threads on the girts right and left hand on either end, these screw into the castings attached to corner posts, and by turning the girts on these threads any desired tension is brought upon the braces, keeping the tower always stiff and firm. Threads on tubes of such large diameter, one inch and one and one-quarter inches, are not seriously affected by rust.

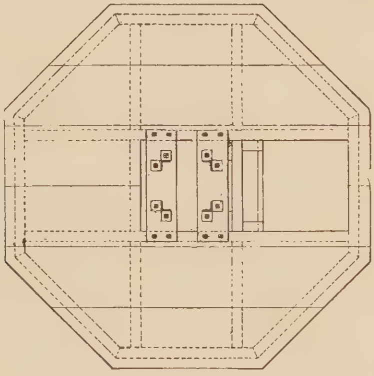
This type of construction, which enables the owner to adjust the tension of the braces at all times, is one which is absolutely necessary to long life in the modern steel windmill tower. All our steel towers are designed to take both steel and wooden windmills; to attach a steel windmill to a wooden tower we furnish a short steel tower, which is shown below. This is a very convenient and satisfactory device for the purpose, very much better than a single post for a steel mill, as by its use the risk of the wheel striking the post and thus injuring the fans is entirely eliminated. It is by far the most substantial and durable arrangement in the market, enabling the change from a wooden to a steel windmill to be made very easily.

10-Foot Eclipse Windmill and 2,200-Gallon Tank, above Building.

Erected on Estate of H. F. COGGSHALL, Esq., Fitchburg, Mass.

The Mill pumps water from a well 26 feet deep, for house, stable and barn uses.



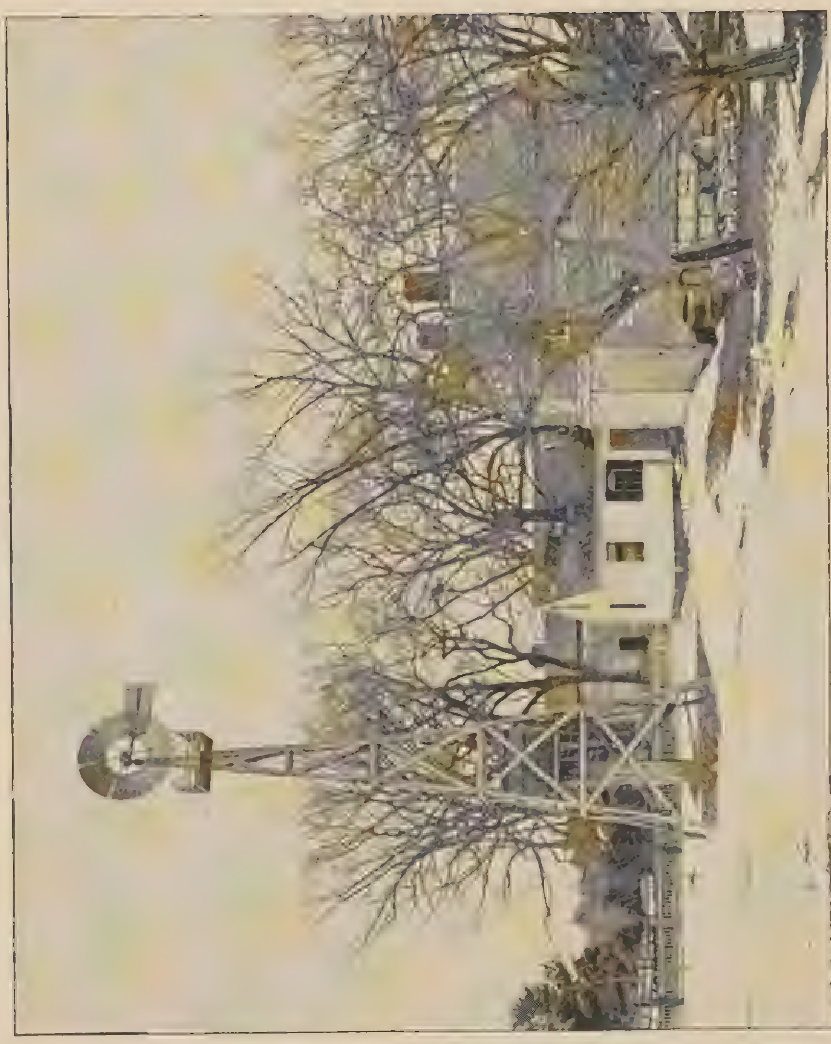


Cuts showing steel stub tower for steel windmill on wood tower, and method of attaching the same.

Special Connections for Pumping Windmills.

In some places the pump must be so located that the windmill cannot be set directly over it, and to communicate the motion of the windmill to the pump either a rockshaft or quadrant connection is used; cut of quadrant will be found on folder descriptive of fourteen-foot geared windmill.

The rockshaft is the simpler arrangement of the two, and when properly made is in every way practically as good as a direct connection, the loss in power being very slight. Our rockshafts are made from special designs, are very heavy and durable, and we have never broken one in service. The quadrant connection is designed for use where the horizontal distance between mill and pump is more than sixty feet, and while very efficient, its use is generally to be avoided, but where conditions necessitate its service, great care should be taken to adopt a pattern of the right construction and then attach it properly. We have, we believe, the heaviest and strongest pattern in the market, and where we recommend its use, will guarantee results. In these special fixtures we have endeavored to recognize the fact that they must fill special requirements, and therefore must be the best that experienced workmanship and design can produce. In no case where we have had to make special connections have we been obliged to abandon the work. We invite inquiry with regard to these details where customers are not able to plan their outfits to meet the demands of their convenience or location. It often happens that it is more convenient to mount a windmill on the end or centre of a barn or other building, thus saving the cost of a tower, and in such cases the rockshaft or quadrant connection often comes into use to good advantage. The cut on page 10 shows a building where a rockshaft is used.



10 Foot Eclipse Junior Windmill on 60-Foot Spiked Tower, With 1,200-Gallon Frost-Proofed Tank.

Erected on Estate of JOHN S. DOLBEARE, Esq., Wakefield, Mass.

This outfit supplies all the water used on his estate.

Small Windmill Outfits for Private Residences, Florists, and Garden Supply.

There is an important field for the use of windmills among people who have simply a residence and garden interest to provide for, in smaller villages and on the outskirts of the large cities, where they lack the advantages of a city water supply. Their requirements include water for household needs, and usually for a horse, cow, and small garden ; the demand is not large, but still sufficient to warrant the investment in a small windmill plant. To provide for this service we are building small windmills, six, eight, and eight and one-half feet in diameter, equipped with special pumps and suitable tanks, with accessories to meet the local requirements, that are very well adapted to the supply of an abundance of water for all these needs. Closely allied with the house water supply is our special line of pumping appliances for the watering of vegetable gardens : for the successful carrying out of this branch of agriculture, water is absolutely necessary. From the hot bed to the marketable stage of growth, the vegetable must be continually watered to reach the surest and highest results. A quick and rapid growth is necessary to all garden products to insure tenderness and delicacy, to say nothing of its importance as a means of securing the earliest market prices. The same is true of all small fruits and flowers. Paying returns from these have to be secured by the most painstaking effort ; faithful watering is the greatest necessity, without which everything else is comparatively useless. This growing demand for an artificial water supply for garden uses is most successfully met by wind power. Its economy, its ease of management, its popular price is already encouraging the general use of artificial watering, and opening a new future to the gardening interest. Strawberry culture especially has responded to the aid of the windmill water supply.

With the increase of the market gardening industry we are putting in many of the above plants ; the windmill, tank and tower may be placed in the immediate vicinity of the hotbeds and fields, with piping leading to convenient localities, where hose bibbs are placed, usually one hundred feet apart, so that a fifty-foot length of hose may be used in watering. In many cases, the tank is located in the field, and the mill is placed at a considerable distance away, over the well, forcing water to it ; often, where the situation allows it, the windmill is dispensed with, and either a hydraulic ram or power pump is used. Again, the tank feature may be left out, and the land irrigated directly from the pump by the use of trenches, though to do this the ground must be fairly level. Relative to this matter, we show clipping from the *Farm and Home*, giving the statement of a customer using two Eclipse mills for this work. "Last spring I dug two wells thirty-five feet deep and put in

8½-Foot Eclipse Junior Windmill on 50-Foot Spiked Tower, with 1,200-Gallon Tank.

Erected for F. S. PARKER, Esq., Wakefield, Mass.

This Mill pumps water from a shallow well, and supplies all that is required for Greenhouses and Gardens.

two pumps, which were operated by two 12-foot Eclipse windmills. During the season I pumped enough water to irrigate five acres of new sod land, and raised crops as follows:

138 sq. rods Onions sold at $1 per bushel	$225
78 sq. rods Melons	80
17 sq. rods Tomatoes	85
40 sq. rods early Cabbage	35
273 sq. rods brought in	$425

Less than two acres brought in $425. The balance of the five acres was used for late cabbage and beans. The beans were flooded while in blossom, and blighted. The late cabbage did not head up on account of the sod land being too slow in maturing them. This season I start in with five acres of land in good condition to farm, and there will be no need of a failure on any of it. I am convinced that irrigation by windmill pumping pays."

Outfits as above described are also widely used by florists who require a considerable supply of water; we also have especial arrangements in this line for dairymen, as illustrated in our tank department further on, showing milk room with tank located on top of building, the mill being located at a distance. The Cape Cod cranberry growers use the Eclipse largely in flooding or draining their bogs; if the lift is short, as it is usually, an immense quantity of water may be handled in a very little time.

There is also a growing demand for small outfits among persons who live in the cities and towns during the winter, and in the summer move to their cottage at the seaside or in the country; their needs for water are moderate, but as a rule what is needed must be pumped by hand or drawn from a well and carried to the house, sometimes at great inconvenience. If the house is fitted with bowls, tubs, and sanitary conveniences, the water must be pumped by hand to a tank situated in the attic of the house, involving more or less labor every day. We are now putting up a great number of windmills for the water supply of these summer houses, having both tank and mill on the same tower; we lead the water directly from the tank to the inside piping, avoiding in this way all expensive plumbing arrangements connected with a tank placed in the house, and an abundant supply of water is always on hand. In many cases house owners club together and put in one plant, which supplies their several families, the cost to each being very small.

We are pleased at all times to submit plans and estimates for outfits as above.

14-Foot Eclipse Windmill on 70-Foot Framed and Rodded Tower, with Stairway.

Erected on the LAWRENCE ESTATE, Fitchburg, Mass.

The Mill pumps water from an Artesian well 90 feet deep, supplying house, stables, greenhouses and lawns.

Pumps as a Part of the Windmill Water System.

Beside a substantial tower, a good pump is necessary to the successful working of a windmill water system. Ever so perfect a windmill is made useless and a failure by the use of an imperfect pump, and a good pump when misapplied, will greatly injure the effective working of the mill. Great care should be taken to have the proper style and size of pump with the windmill for a given place; it should be easy in its working and of simple construction. Our long experience in the windmill business leads us to emphasize the importance of practical features in a good windmill pump. The first is that the pump should not be of complicated construction. Windmills are largely left to take care of themselves, and any complicated pump is apt to get out of order. Customers cannot always secure the services of expert help in the repair of a pump, which proves a double source of annoyance. The style of pump best adapted to ordinary use is that which embodies the original principle of a suction and lift pump, or what is here termed a "single-acting pump." For simplicity and durability, and for freedom from accident or disturbance because of ordinary contingencies, these are better adapted for windmill use than any other type. This applies to the smaller sizes of windmills more particularly than to the larger plants, because the smaller outfits are not likely to be in charge of experienced mechanics. In some cases a double-acting pump is be preferred, but they are more sensitive to disturbance and require more attention and repair than the simpler single-acting pump. We recommend a double-acting pump in our larger plants, because with a large windmill they utilize what would otherwise be waste power, and as these outfits are likely to be given more care and attention than the smaller ones, the pump will receive its due share and consequently run little danger of serious neglect.

One of the advantages of single-acting pumps for use with small outfits, is in their giving an intermittent strain, in pumping, on the windmill. They do not tax the power of the mill on the down stroke, and by thus relieving it part of the way round, enables it to get up momentum to carry it over on the up stroke in lifting the water. In this way windmills are made to run in light winds with single-acting pumps, where double-acting pumps would overload. This suggests a point with regard to the size of cylinder for windmill pumps. These should always be smaller than those for hand use; in pumping by hand, time is of greater value than hard work, and the pump that will throw the water most rapidly is the most desirable. With windmills the case is reversed; time is nothing, as the average mill is not required to run more than two hours a day to pump the water, leaving the remaining twenty-two hours of the twenty-four unoccupied, but to insure the necessary two hours a day for pumping, windmills must be able to run with a mere breath of wind current. During the hot months of July and August there are weeks at a time when the movement of the winds is hardly perceptible. To guard against failure at these times, the mill must be given as light a load as possible to carry. A small cylinder, in such cases, even

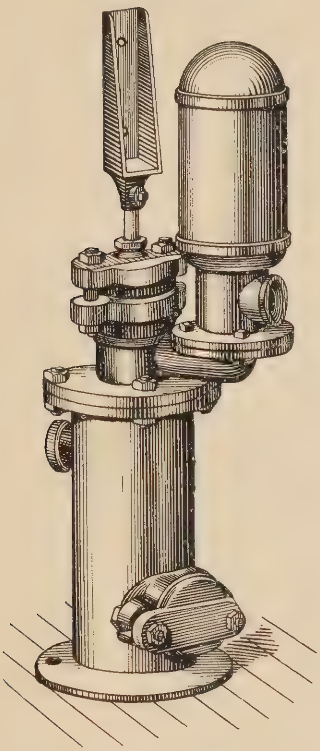
though it will require twice the length of time to pump the water with it, is more economical. It will insure the working of the mill every day when otherwise it might prove intermittent. The small cylinder does not wear the mill in pumping as a large one; the large cylinder, by pumping water rapidly, increases the friction and crowds it through the pipe, thus augmenting proportionately the strain on the mill.

Here it is proper to speak of the different kinds of cylinders; these are classified as shallow and deep-well cylinders and are made of iron or brass. The deep-well cylinder differs from the shallow well in having a longer barrel and plunger. This long plunger is supposed to act as a guide and an additional security to the packing under the strain of a deep-well pressure. As to the claims of iron and brass cylinders, the iron is less liable to be injured in being packed and repacked. The brass, on the other hand, does not corrode with rust, and consequently does not produce as much friction in the working of the valves, nor does it impregnate them with any metallic deposit so as to ruin them, as do the iron: we always recommend the brass cylinder as by far the most satisfactory. The cylinder as a part of a pump is the most vital: it does all the drawing and lifting and the least derangement or deficiency in it destroys successful operation. Our cylinders are made with the greatest care, being carefully fitted and all the threads cut to an exact gauge. The valves are also made of the best "Oak Tan" leather and furnished with raised valve seats. In the make up of our pumps, both single and double acting, we have endeavored to meet every requirement, and the pattern we have now adopted is, without question, the most convenient and satisfactory that can be had; it is made upon the most practical principles, and will give the best results with the least possible care on the part of the owners.

Eclipse Force Pumps for Shallow Wells.

Figure 35 shows our Single-Acting Pump for windmill use. It combines in its make up more advantages than any other single-acting pump in the market, and has had many imitators. It is built on the syphon principle, taking in its supply from the suction pipe at a point high enough above the base to ensure its holding at all times a quantity of water sufficient to prime it in case the vacuum is lost from any cause. This self-priming feature makes it the most reliable pump to use under a windmill. Its construction is very simple and consists of an outer chamber or jacket of large diameter, within which a brass cylinder is so located that the plunger and lower valve are submerged when the pump is filled with water. The large outer jacket holds a sufficient quantity of water to prime the working parts long enough to ensure the making of a perfect vacuum in a long and high lift on the suction end, and a large space around the top of cylinder makes a vacuum chamber that relieves the pounding of the valves when running at full speed. This gives the valves the greatest possible efficiency and long life, and enables them to perform duty even when so materially worn as to be useless in any other style of pump. Not less in

Fig. 35.



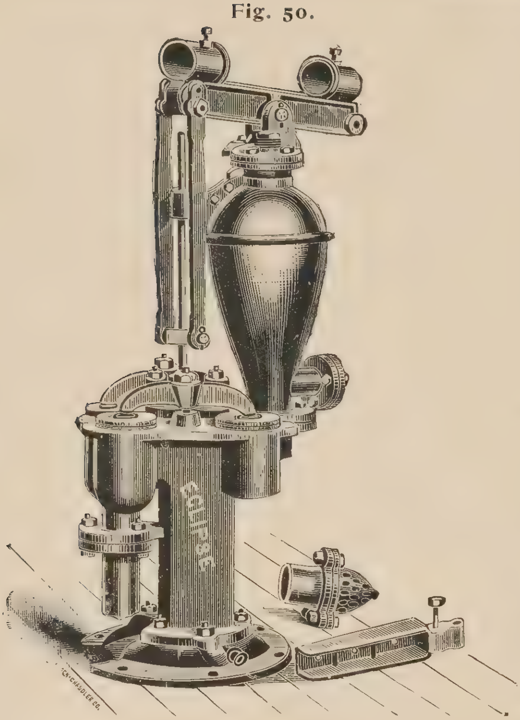
importance is the feature of the ready accessibility of the working parts in this pump, it being so made that the plunger, piston rod and lower valve can be taken out for examination by any one not familiar with pumps, with a common monkey-wrench, without disturbing the pipes, a very important consideration with customers who cannot afford or command expert service. All the working parts are brass, making them very durable and very easy to take apart, there being no rust to corrode. The bolts on the caps are made with coarse threads so that rust does not affect them, even after years of service. The air-chamber avoids the loss of air from having a piston rod run through it, as in some other syphon pumps, and is located at the proper point to cushion the column of water in the discharge pipe; the check valve between the air-chamber and pump relieves the working parts of all strain when at rest. The flange on main jacket of pump is arranged so that the discharge outlet can be swung around on its centre, making it possible to adapt the pump to widely-varying situations, and also reduce the number of turns in the piping, where a lack of this feature involves a serious loss of power from friction and "water hammer." Taken altogether the combination of the working details of this pump make it the most serviceable and popular in the market. Its parts are interchangeable, and repairs are easily and cheaply made. It is built in four sizes, as listed below.

PRICE LIST OF FIG. 35 SINGLE-ACTING PUMP.

Sizes.	Diameter Inner Cylinder.	Stroke.	Suction and Discharge.	Price.
No. 0	2 Inch.	8 Inch.	$1\frac{1}{4}$ Inch.	$18.00
" 1	$2\frac{1}{2}$ "	8 "	$1\frac{1}{4}$ "	22.00
" 2	3 "	8 "	$1\frac{1}{2}$ "	28.00
" 3	4 "	10 "	2 "	50.00

Our Figure 50, Double-Acting Suction and Force Pump, is especially used for heavy service and in connection with our Railroad Pumping Windmills, and is constructed with special reference to durability and the convenience of the owner. Every valve has an independent cover, and all parts are readily accessible with an ordinary monkey-wrench. It is brass fitted throughout, with metal, rubber or leather valves, as ordered. We have patterns for extra heavy duty, for pumping against a pressure of two hundred feet elevation or over. It is provided with drip plugs for draining in cold weather, and has every appliance for all-around service.

Fig. 50.



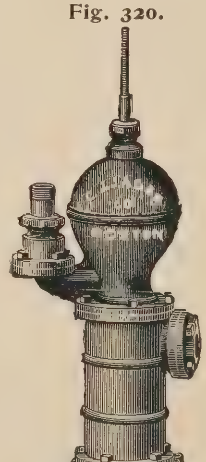
When desired a hand lever can be attached, making it independent of the windmill or driving engine at all times. Its valve and valve seats are of the most approved pattern, making it one of the most durable and efficient pumps offered to the trade. All our force pumps are suitable for use as power pumps, and can be driven to high speed under heavy duty without excessive wear.

PRICE LIST OF FIG. 50 DOUBLE-ACTING PUMP.

Diameter of Cylinder.	Stroke.	Suction Pipe.	Discharge Pipe.	Price.
$2\frac{1}{2}$ In.	8 In.	$1\frac{1}{2}$ In.	$1\frac{1}{2}$ In.	$ 65.00
3 "	8 "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	70.00
3 "	12 "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	85.00
4 "	12 "	2 "	2 "	100.00
5 "	12 "	3 "	$2\frac{1}{2}$ "	120.00
5 "	16 "	3 "	$2\frac{1}{2}$ "	155.00

Fig. 320 shows our Syphon Pump, which has been extensively used in the past and until superseded by our improved Fig. 35, which entirely overcomes any objections that may be presented to the older style. Fig. 320 is substantially and strongly made; it is well adapted to general pumping work; comparing it with Fig. 35, its main difference is that it is not so easy to overhaul. Take, for instance, the most common of pump repairs, the renewal of the leathers; if it is desired to re-leather the plunger of our Fig. 35, it is only necessary to take off the upper cap, disconnect the pump pole and withdraw the plunger, without disturbing the piping or any other part. To re-leather the plunger of Fig. 320 requires the uncoupling of the piping at the discharge outlet, and the removal of the air-chamber with piston rod and plunger. To replace the lower valve of our Fig. 35, calls for the removal of the plate bolted to the side of the pump; in Fig. 320 the piping must be disconnected and the air-chamber and plunger removed as before. To say nothing of the difficulty in replacing the pipe connection in exactly its former position and making a perfectly tight joint, the time consideration must be taken into account; either operation on the Fig. 35 pump takes not more than half an hour, with Fig. 320 at least half a day. However, the good qualities of Fig. 320 create a demand for it where the matter of expense is a controlling factor. It is made in all sizes up to six inches in diameter, but we list only the first three, these being ordinarily

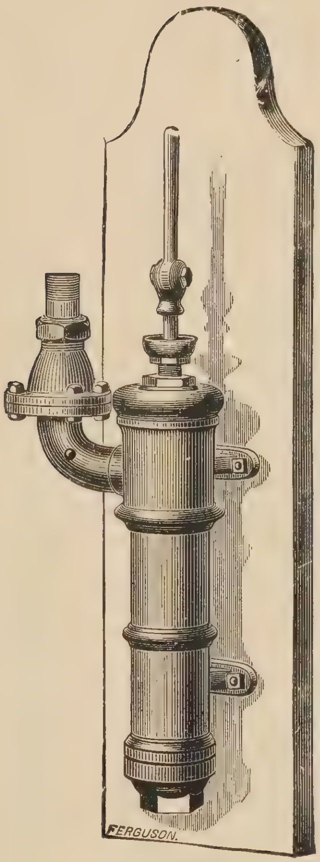
Fig. 320.



PRICE LIST OF FIG. 320 SYPHON PUMP.

No.	Size Cylinder.	Suction.	Discharge.	Brass Lined Cylinder.	Brass Cylinder.
1	$2\frac{1}{2}$ In.	$1\frac{1}{2}$ In.	$1\frac{1}{4}$ In.	$17.00	$18.25
2	3 "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	17.25	18.75
3	$3\frac{1}{2}$ "	2 "	2 "	18.00	20.75

Fig. 500.



used on windmill work. It is fitted with brass lined or solid brass cylinder, as per list, and has brass stuffing box and plunger. It is a first-class, low-cost pump, having held the lead in its line for years, until quite recently.

Fig. 500 shows our light Force Pump, mounted on plank and arranged for Pitman connection. It is usually fitted for wood pole connection for windmill, as ordered. It has leather valves, and is made in iron and brass. For loads under fifty feet elevation, this pump is very well adapted, and will give excellent results.

PRICE LIST OF FIG. 500 FORCE PUMP.

No.	Size Cylinder.	Suction and Discharge Fitted for	Stroke.	Price.	
				Iron.	Brass.
1	2 In.	1 In. Pipe.	7 In.	$7.50	$16.00
2	2½ "	1¼ " "	7 "	8.00	18.00
3	3 "	1¼ " "	7 "	8.50	20.00

Eclipse Force Pumps and Cylinders for Deep Wells.

Fig. 40.

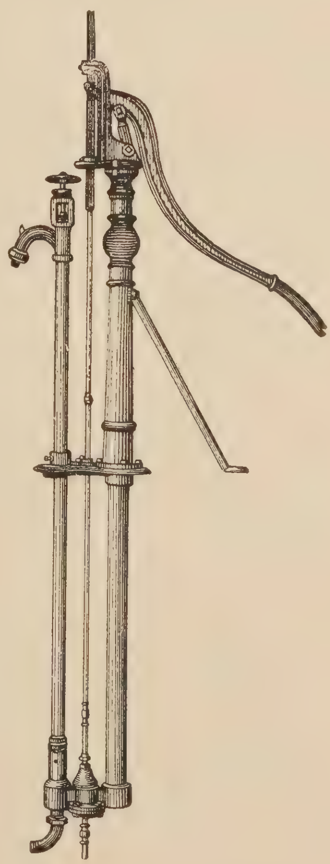


Fig. 40 shows our Deep-Well, Anti-Freezing Hand Pump, arranged with improved vertical three-way valve. Its construction admits of withdrawal of the plunger, without disturbing the pump head or pipe connections. It is provided with a large air-chamber, which insures an ease of operation, and a steady flow of water. With this pump water can be delivered at the well platform, or forced to the tank, as the operator may desire.

Fitted for two-inch suction pipe, one-inch discharge pipe, with ten-inch stroke.

Price . . $14.00

Fig. 33.

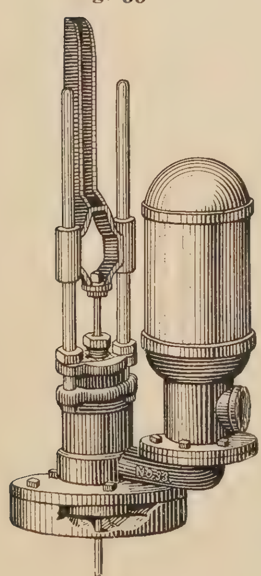


Fig. 33 is our Deep-Well Stuffing Box Head with discharge check-valve, air-chamber and guided piston rod, and is arranged for use either by power or windmill. It is provided with ring on its base to fit threads on the well casing,

10,000-Gallon Frost-Proofed Tank, on 28-Foot Framed and Rodded Tower.

Erected on Estate of J. B. SHURTLEFF, Esq., Revere, Mass.

This Tank is supplied by the windmill shown on Page 6.

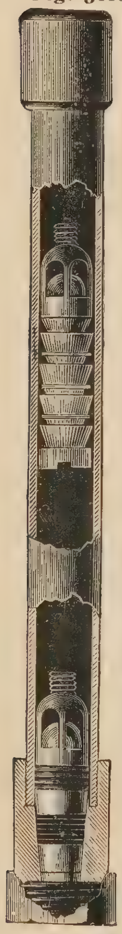
thus making a cap for the well and a secure support for the pump. If the location does not permit of its use the ring can be dispensed with.

Fitted for three-inch suction, one and one-half discharge pipe and six-inch well casing, with eight-inch stroke.

PRICE $14.00

These pumps are especially designed to be used in connection with the cylinders listed in following pages, and give excellent results. They are used in wells up to three hundred feet in depth, and are made strong, with special reference to durability and freedom from repair.

Fig. 311.



Artesian Well Brass Cylinders, with Brass Ball Valves.

The cylinder or working barrel shown in cut, is made of heavy seamless drawn brass tubing, perfectly smooth and true. It has been designed to meet the heavy and exacting duty of pumping in the deep wells of the oil regions, and its excellent service for this purpose has opened for it the field of windmill work. The inside diameter of the cylinder is smaller than the pipe it is to be used in connection with, thus allowing the plunger and lower valve to be drawn up out of the pump to be repacked without disturbing the pump head or pipe, thus making a convenient and durable arrangement. Its valves are made of gun metal, spherical in shape, and will wear for an indefinite period. The working parts being all brass, there is no chance for rust to form and injure the plunger leathers, and the lower end is threaded for pipe, so that a strainer can be attached to the suction. We list only the sizes in most common use, and will make prices on larger sizes up to nine and one-half inches in diameter, with thirty-six-inch stroke, on application.

PRICE LIST OF FIG. 311 BALL VALVE CYLINDERS.

Inside diam. of Cylinder.	Pipe or casing for top attachments.	Pipe or casing for bottom attachments.	Extreme length of Cylinder.	Capacity in gallons, per stroke.	Cylinder complete for 10-inch stroke.	Cylinder complete for 16-inch stroke.
1⅜ In.	1½ Inch.	1½ Inch.	32½ Inch.	.10		$15.00
1¾ "	2 "	2 "	32½ "	.17	$17.00	18.00
2¼ "	2½ "	2 "	35 "	.27	22.00	24.00
2¾ "	3 "	2 "	42 "	.41	28.00	32.00
3¼ "	3½ "	2½ "	43 "	.57	38.00	50.00
3¾ "	4 "	3 "	45 "	.77		70.00

These cylinders are used in connection with our Fig. 40 and Fig. 33 pump heads, and make with them the best deep-well pump that we have seen.

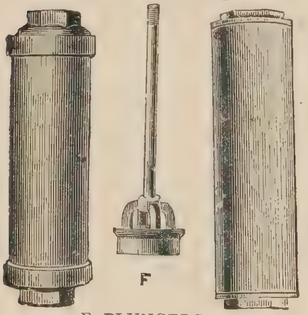
Eclipse Seamless Drawn Brass Cylinder, for Deep or Shallow Wells.

These cylinders, as shown on following page, are used extensively in the make-up of pumping outfits of all kinds. As they form the vital working part of the pump, it is of the greatest importance that they be made of the best material and accurately fitted. The Eclipse cylinders are as reliable and as well made as any that can be had, and our long experience in this work enables us to offer a most satisfactory line of goods. We have these in a great variety of forms, but offer in the list the sizes most commonly used for windmill work.

The only difference between Figs. 312 and 322 is that the latter has inside caps or attachments, while the former has outside caps or attachments, the prices being the same for both.

PRICE LIST OF FIGS. 312-322 SEAMLESS DRAWN BRASS CYLINDERS.

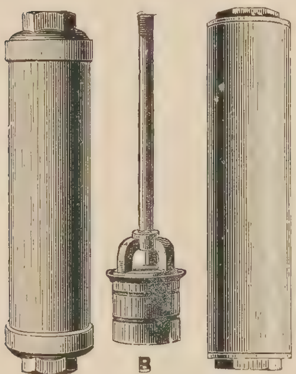
Fig. 312. **Fig. 322.**
10 and 12 inches long.



F. PLUNGERS.

Sizes.	F. Plunger.	Iron Caps.	All Brass.
2 by 12 inch	Fitted for 1 inch pipe.	$ 8.00	$ 9.00
2¼ " 12 "	" " 1¼ " "	8.25	9.25
2½ " 12 "	" " 1¼ " "	8.50	9.50
2¾ " 12 "	" " 1¼ " "	9.00	10.00
3 " 12 "	" " 1¼ " "	9.50	11.00
3¼ " 12 "	" " 1¼ " "	10.25	11.75
3½ " 12 "	" " 1½ " "	11.25	13.50
4 " 12 "	" " 2 " "	15.00	18.50

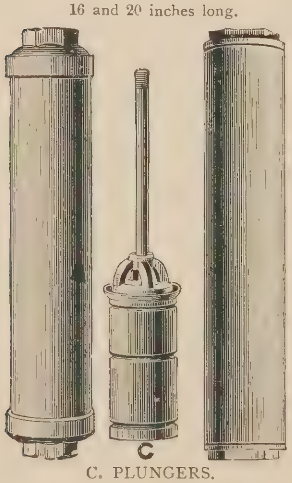
Fig. 312. **Fig. 322.**
14 inches long.



B. PLUNGERS.

Sizes.	Fitted for	Iron Caps and Follower. Brass Cage and Valve.	Iron Caps and all Brass Plunger.	All Brass.
2 by 14 inch	1 inch pipe.	$ 8.50	$ 9.75	$11.25
2¼ " 14 "	1¼ " "	9.00	10.25	11.75
2½ " 14 "	1¼ " "	9.25	10.50	12.00
2¾ " 14 "	1¼ " "	9.75	11.25	13.00
3 " 14 "	1¼ " "	10.25	11.75	13.50
3¼ " 14 "	1¼ " "	11.00	12.75	14.50
3½ " 14 "	1½ " "	12.25	14.75	16.25
4 " 14 "	2 " "	15.75	19.00	21.50
4½ " 14 "	2 " "	18.00	23.00	26.00
5 " 14 "	2½ " "	20.50	26.50	30.50
6 " 14 "	3 " "	24.00	34.00	40.00

Fig. 312. **Fig. 322.**
16 and 20 inches long.



C. PLUNGERS.

Sizes.	Fitted for	Iron Caps and Follower. Brass Cage and Valve.	Iron Caps and all Brass Plunger.	All Brass.
1¾ by 16 inch	1 inch pipe.	$ 9.00	$10.50	$12.00
2 " 16 "	1 " "	9.00	10.50	12.00
2¼ " 16 "	1¼ " "	9.75	11.25	12.75
2½ " 16 "	1¼ " "	10.25	11.75	13.25
2¾ " 16 "	1¼ " "	10.75	12.25	13.75
3 " 16 "	1¼ " "	11.25	12.75	14.75
3¼ " 16 "	1¼ " "	12.00	14.00	16.00
3½ " 16 "	1½ " "	13.50	16.00	18.50
4 " 16 "	2 " "	17.50	20.50	24.00
4½ " 16 "	2 " "	21.00	26.50	30.50
5 " 16 "	2½ " "	24.00	31.00	36.00
6 " 16 "	3 " "	30.00	42.00	49.00

Drive Well Points.

We list a few of the drive points most commonly used in well work; these are made of galvanized iron pipe, and used extensively where the nature of the soil permits a free flow of water through the ground.

Fig. 631.

PRICE LIST OF WASHER POINTS.

1¼ Inch Points.—Galvanized.

Prices Per Doz.

Trade No.	Length Pipe.	No. Holes.	No. 60 Gauze.
300	20 Inch.	50	$30.00
301	2 Feet.	60	36.00
302	2½ "	80	46.00
303	3 "	100	56.00
304	3½ "	120	66.00

1½ Inch Points.—Galvanized.

Prices Per Doz.

Trade No.	Length Pipe.	No. Holes.	No. 60 Gauze.
321	2½ Feet.	110	$60.00
322	3 "	130	72.00
323	3½ "	150	84.00

PRICE LIST OF BRASS JACKET PIPE WELL POINTS.

1 Inch Points.—Galvanized.

Prices Per Doz.

Trade No.	Length.	Jacket.	Holes.	No. 60 Gauze.
74	2 Feet.	18 Inch.	70	$33.00
76	2½ "	24 "	100	42.00
78	3 "	30 "	120	51.00
80	3½ "	36 "	140	60.00
82	4 "	42 "	160	69.00

1½ Inch Points.—Galvanized.

Prices Per Doz.

Trade No.	Length.	Jacket.	Holes.	No. 60 Gauze.
136	2 Feet.	18 Inch.	120	$ 48.00
140	2½ "	24 "	160	60.00
144	3 "	30 "	200	72.00
146	3½ "	36 "	230	84.00
148	4 "	42 "	270	96.00
152	5 "	54 "	350	120.00
156	6 "	66 "	420	144.00

1¼ Inch Points.—Galvanized.

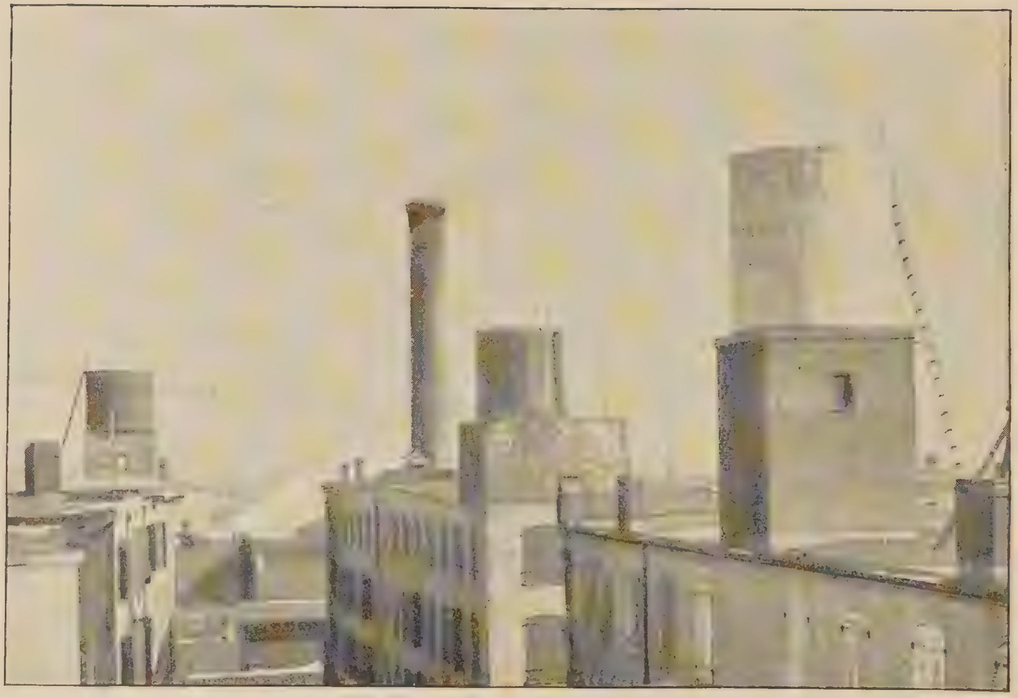
Prices Per Doz.

Trade No.	Length.	Jacket.	Holes.	No. 60 Gauze.
86	20 In.	14 Inch.	80	$ 30.00
90	2 Feet.	18 "	100	36.00
94	2½ "	24 "	125	46.00
98	3 "	30 "	150	56.00
100	3½ "	36 "	175	66.00
102	4 "	42 "	200	76.00
106	4½ "	48 "	225	86.00
110	5 "	54 "	250	96.00
114	6 "	66 "	300	116.00

2 Inch Points.—Galvanized.

Prices Per Doz.

Trade No.	Length.	Jackets.	Holes.	No. 60 Gauze.
160	2 Feet.	18 Inch.	140	$ 75.00
164	2½ "	24 "	200	90.00
168	3 "	30 "	260	105.00
170	3½ "	36 "	290	120.00
172	4 "	42 "	330	135.00
176	5 "	54 "	430	165.00
180	6 "	66 "	530	195.00



5,000 and 7,500-Gallon Tanks, Erected for Storage and Sprinkler Service in this City.

These are enclosed in metal, to conform to requirements of Building Inspectors. The supports are made either by carrying up the elevator wells, or the corner walls of buildings.

Revised Price List of Pipe Fittings.

Sizes, Inches	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4
Elbows, Cast	4	5	6	9	13	20	25	40	75	1.10	1.35	1.80
" Redc. or R. & L.	5	6	7	11	16	23	29	46	85	1.25	1.50	2.10
" Malleable	5	7	9	15	22	32	38	60	1.25	1.75	2.10	4.00
" Galvanized	6	9	12	18	30	45	55	85	1.60	2.35	3.10	4.10
Tees, Cast	6	7	9	13	20	30	38	60	1.10	1.50	2 00	2.50
" Reducing			11	15	23	35	44	70	1.25	1.75	2.30	2.90
" Malleable	7	7	9	18	29	40	48	75	1.40	2 10	2.50	4.15
" Galvanized	7	10	14	20	36	55	85	1.20	2.25	2.85	3.80	5.25
Crosses, Cast	8	10	12	18	28	40	50	80	1.50	2.20	2.70	3.50
" Reducing	10	12	14	21	32	46	58	92	1.70	2.50	3.00	4.00
" Malleable	8	10	12	20	30	42	55	85	2.00	3.10	4.00	5.75
" Galvanized		15	20	32	50	80	1.00	1.60	3.00	4.25	5 50	7.00
Reducers, Cast									75	1.20	1.50	2.00
" Malleable		6	9	12	18	25	36	50				
" Galvanized		8	11	16	25	35	45	75	1.05	1.65	2.40	3.05
Plugs, Plain	3	3	4	5	6	10	13	20	35	50	75	85
" Galvanized	5	5	6	8	10	15	23	35	57	95	1.35	1.60
Bushings, Plain		5	6	7	9	13	17	27	42	60	80	1.00
" Galvanized		6	7	10	14	21	30	44	59			
Caps, Cast									50	80	1.10	1.30
" Malleable	3	4	5	8	12	16	24	32	45	70	85	1.20
" Galvanized	5	5	8	12	16	24	38	52	76	1.15	1.40	2.00
Couplings, Wrought	5	6	7	10	13	17	21	28	40	60	80	1.00
" Galvanized	6	8	10	13	18	25	32	40	55	80	1.05	1.40
" Mal. R. & L.	4	5	9	12	18	25	36	52				
" Gal. "	8	10	13	20	25	35	50	75				
Nipples, Short	5	6	7	9	10	14	17	25	56	75	1.00	1.25
" Long	7	9	10	11	15	20	25	35	75	95	1.25	1.60
" Short, Galv'd.	7	8	9	11	13	17	23	32	65	1.00	1.25	1.45
" Long "	9	11	13	16	19	24	31	40	85	1.20	1.50	1.90
Locknuts, Malleable	4	4	6	7	8	10	12	25				
" Galvanized	5	5	7	9	10	12	16	32				
" Cast									40	50	70	95
Unions, Malleable	15	18	20	28	34	46	60	80	1.50	2.10	3.00	4.00
" Galvanized	20	24	27	37	50	70	90	1.20	2.25	2.90	4.50	5.60
Flanged Unions, Crane's new Pattern.				65	70	85	1 15	1.50	1.75	2.25	2.75	3.15

Price list of plain and galvanized iron pipe will be mailed on application.

30,000-Gallon Frost-Proofed Tank, on 15-Foot Framed and Rodded Substructure.

Erected on Estate of Hon. ROBERT TREAT PAINE, Waltham, Mass.

This Tank is filled by the Windmill shown on page 34, and is used for the storage for water supply on the above Estate.

Tanks.

The tank is as much a part of the water-supply system as the windmill, tower or pump, and in the development of the business nothing has undergone greater change and modification. It is necessary to have at least three or four days' supply of water stored in the tank to provide not only for lack of wind, but also to make the outfit one which will develop the full capacity of a weak well, by storing up the water pumped by the windmill as fast as the well will furnish it.

The first use of a tank, in connection with a windmill, was to place it on the ground, allowing the windmill to pump directly into it and the cattle to drink from it at will. The capacity of the tank was gradually increased until they would hold three or four days' supply. After some time the advantage of having this tank elevated so that the water could be drawn through piping to the watering trough and house became apparent, and the tank was placed in the barn, or some other building. This plan has its disadvantages, and the latest and best arrangement is to elevate the tank on an independent tower, placing the windmill above it, thus combining the whole water-supply system in one structure. The requirements for the first-mentioned use of the storage tanks are discussed under the heading of "Frost-Proof Stock Tanks," and with regard to the placing of the storage tanks in barns and other buildings, we must warn a customer that a thousand gallons of water weighs four tons, and the supports for the ordinary size tank used for our windmill water-supply system must be strong in proportion to the weight resting upon them. There must be in the floor timbers, under a tank, sufficient strength to support the load rigidly, without the ordinary deflection allowed by the best engineers as being perfectly safe for other loads. Such bending or yielding of the supports will result in the straining of the tank, and the consequent leakage, which will rot the woodwork. In places where any leakage would cause damage, we usually supply a sheet-metal pan under the tank, to provide for accidental leakage or overflow. Tanks in buildings can be made frost-proof for ordinary requirements by a tight cover on top, but if it is necessary to further protect them from frost, they should be made of three-inch stock. It is not wise to pack any material around a tank to protect it from the frost, as this causes premature decay. Pipes leading to tanks inside buildings can be boxed to prevent freezing, so that the water supply, when frost-proofed, can be used regardless of the outside temperature.

The best form of storage is the independent elevated tank on structure. In this arrangement it can be rigidly and properly supported, protected from frost, and may be elevated to a height which will carry the water to all distributing points. Large tanks can be more readily frost-proofed than small ones, and better results are obtained by using three-inch material than two inch, if the conditions are very severe. The best shape for a tank is round, rather than oblong or square, as the round tank is more readily fitted and more evenly supported by its bands or hoops, and is less liable to leakage. Owing to the difficulty in making a square tank tight

2,200-Gallon Frost-Proofed Tank.

Erected on stock farm of CHAS. A. KING, Esq., Mattapoisett, Mass.

This Tank is supplied by a Windmill at a distance (see page 40); it is located directly over the dairy-house, and furnishes running water for the same.

at the corners, it is best to line it with sheet metal, copper preferably, and care should be taken to use metal heavy enough to stand considerable strain, if the tank should yield under insufficient support of its fastenings or foundation. A tank having great depth requires very much stronger fastenings or hoops than if shallow, and in a square tank it is not advisable to exceed four feet in depth.

Although we can furnish tanks of any kind of lumber, cypress, oak or cedar, we recommend the use of western pine, and unless otherwise specified, tanks will be built of this wood, sound, selected stock, surfaced both sides, free from shake, or unsound knots. Long experience has shown that pine of good quality is superior to either cypress or cedar, it being almost impossible to obtain the last-named wood of the length and grade necessary to meet the demands of the trade.

All tanks are carefully fitted together and marked before leaving the factory, and are shipped in knockdown, with the hoops coiled up in convenient form for handling. The bolts for the lugs, and the dowel-pins, are boxed. Weights given in the list are approximate, as this depends on the dryness of the lumber. Tanks are not painted when shipped, and will not leak if properly set up. All necessary instructions for setting up tanks will be cheerfully furnished on application.

Special attention of those interested is directed to the screw-clamp lugs on our hoops, which are of great value in the construction of a tank. The hoop, having been laid in position around the tank, a bolt is passed through the lugs, and the nuts on the bolt turned up with a wrench. By this means all the joints are drawn up perfectly tight.

In cases where tanks are allowed to stand empty for a time, there is more or less shrinkage, and a driven hoop is likely to become so loose as to be worthless for holding purposes, when the tanks are refilled, and must be refitted to its place to be of value. With lug hoops the tank can be screwed up tight, after shrinking, thus making the lugs an almost indispensable feature. In setting up the tank, these lugs can be placed to suit the exigencies of the work, while the riveted hoops must be forced into place from all parts of the tank, this being often difficult, and sometimes impossible.

Prices will be as low as is consistent with first-class work, and estimates will be furnished for tanks of any size, and, if desired, the cost of placing one or more in position, with a suitable support for same.

We have found that while cypress is unexcelled for use in a warm building, or any place where the temperature is even, it is unsuitable when exposed to the extremes of the New England climate. This wood is soft and coarse grained; it grows in the water of the southern swamps, and is very porous. The difficulty we have found in the use of this material for tanks is, that the staves and bottom become thoroughly saturated: in the winter this freezes, and results in the straining of the joints and splitting of the wood. In the summer months these tanks are tight, but in the winter, owing to the freezing above mentioned, they leak, and are a constant source of annoyance. The pine tanks are not porous, and are tight, summer and winter.

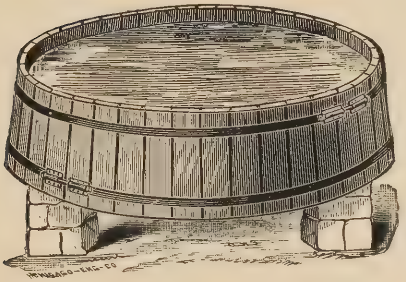
A claim for the superiority of cypress tanks over pine is that the water stored in the former is less likely to taste of the wood than the pine. This is false, and displays an entire ignorance of the facts; we are constantly selling pine tanks, and have yet to hear the first complaint of this nature. The sap of pine is less bitter and acrid than that of cypress, and will not affect the water.

30,000-Gallon Storage Tank on 10-Foot Substructure.

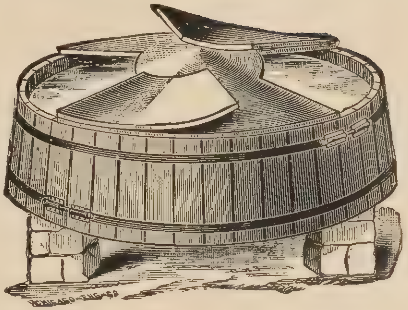
Erected on Estate of Mrs. MARTIN HAYES, Hingham, Mass.

This Tank is supplied by a 5-inch x 6-inch Triplex Pump, operated by a 5 Horse-Power Gasolene Engine. The Pump discharges 50 gallons of water per minute, from a dug well, through 400 feet of three-inch pipe into the Tank, 115 feet above the source of supply.

Frost-Proof Stock Tanks.



Without Cover.



With Cover.

Our Stock Tanks are designed for farm use, watering stock, cooling milk, etc. We have endeavored, in their construction, to guard against the annoyance caused by frost in the winter, and the use of hundreds of these tanks all over the country is abundant proof of their substantial character. Railroad companies have for years relied on the thickness of the tank lumber in their water stations, together with the roofing of their tanks, which prevents the latent heat of the water from escaping, for their frost-proofing. We suggest the importance of providing a good foundation for any stock tank; it should be firm enough to sustain the weight of the water it contains without settling. This is no trifling matter, as the weight of the water in the larger tanks amounts to tons. If the tank settles out of level, from insufficient support, it is strained, and the joints are likely to be forced apart so as to form a permanent leak.

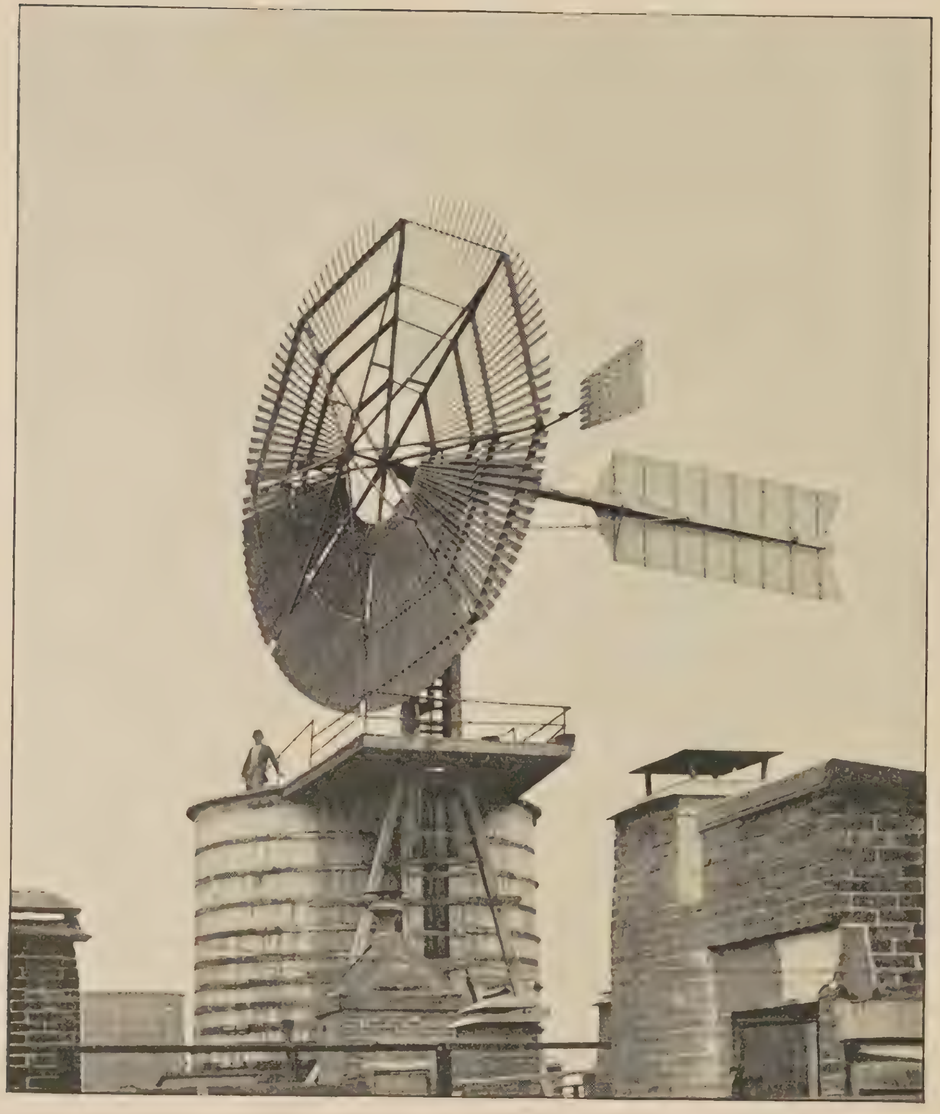
(For Price List see the end of this book.)

The Eclipse Tank Heater.

In locations where tanks cannot readily be made frost-proof, we call attention to the Eclipse Tank Heater. This heater is made of galvanized iron, and is arranged to be bolted to skids, to be placed across top of the tank. When not in use, it can be easily set aside. Its price, $14.00, is saved in a very short time in the benefit derived by the stock from drinking water which has the chill taken out.

Independent Water-Supply System in Cities.

We have been successful in introducing water-supply outfits for manufacturing and tenement properties in cities where the charge for water rates has been a burden, or the quality of the water is such as to make it unfit for special purposes. We show, on page 64, storage tanks erected on suitable supports above the roofs of buildings in this city, which are used as reservoir tanks for automatic sprinkler service; the construction of these tanks and substructures is similar to those used for water supply. It frequently happens that a well can be driven in the cellar or premises adjoining a manufacturing building, which will furnish a supply of water for all purposes, if pumped into a tank placed above the roof, from which it can be distributed to the different floors where it is to be used. A durable and efficient plant of this sort is a profitable investment, as the cost of the power required for pumping with the improved appliances now at hand for this purpose, is less than would be supposed, and we look for a continued increase in this department of our business, because of the saving in water rates to our customers.



25-Foot Eclipse Windmill and Two 30,000-Gallon Tanks on roof of Tenement Building.

Erected for E. D. BROOKS, Esq., Cambridge, Mass.

The Mill pumps water from an Artesian well 200 feet deep.

Having power already in the building, it is usually a very simple matter to attach a suitable power pump and connect it to the well and tank, thus providing a complete water-supply system, which will meet every need, at a cost often less than one half the former charges. The expense of a tenement-house supply from the city service is often so large as to compel the owners to install an independent system, and we refer to cut on opposite page, showing windmill furnishing the power for this purpose.

We are also using very successfully, on some country estates where the consumption of water is very large, a combination of our Gasolene Engine and Triplex Power Pump, using for storage, tanks holding from 30,000 to 100,000 gallons. On page 70 will be found a statement showing the work done by one of these outfits.

We solicit inquiry in regard to this subject, and will cheerfully furnish plans and estimates for proposed work of this kind, upon application.

Our "Triumph" Horizontal Double-Acting Force Pump is often used where power is available, in the same way as the Triplex Pump above.

Fig. 609.

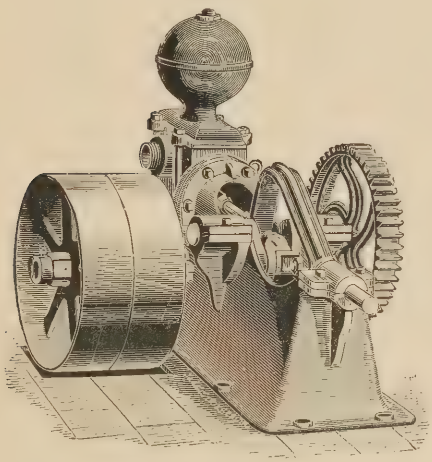


Fig. 609, as illustrated, shows our Geared "Triumph" Pump, with tight and loose pulleys, which is calculated to work under heavy pressure. It is substantially constructed in all its parts. The pump is bolted to a heavy frame, and the crank shaft, rod guide, yoke and pitman are so arranged as to keep the piston always in line with the cylinder.

In pumping against a pressure up to one hundred pounds to the square inch, this pump should be run at the rate of thirty to fifty revolutions per minute. The pump is geared to increase power three to one; this would make the speed of pulleys from ninety to one hundred and fifty revolutions per minute.

When this pump is to be used for feeding steam boilers, it should be so specified in the order, since for this purpose the piston should be made of hard brass or bronze. The piston rod, the valves and valve seats, are always made of bronze, and the cylinders are brass-lined, except in the "brass" pumps, which have all-brass cylinder.

PRICE LIST OF FIG. 609 TRIUMPH PUMP.

No.	Size Cylinder.	Suction Fitted for	Discharge Fitted for	Stroke.	Size of Pulleys.	Capacity per Stroke.	Brass-Lined Cylinder. Price.	All-Brass Cylinder. Price.
1	2½ In.	1¼ In.	1¼ In.	4½ In.	16x4 In.	.20 Gal.	$ 75.00	$125.00
2	3 "	1½ "	1¼ "	4½ "	16x4 "	.30 "	80.00	130.00
3	4 "	2 "	1½ "	4½ "	16x4 "	.50 "	85.00	145.00
4	5 "	2½ "	2 "	4½ "	16x4 "	.87 "	115.00	185.00

25-Foot Eclipse Geared Windmill, on 100-Foot Framed and Rodded Tower.

Erected on Estate of W. E. C. EUSTIS, Esq., Milton, Mass.

The Mill is equipped with two Fig. 50 Eclipse Double-Acting Pumps, furnishing water for house, stable, greenhouses, lawns, etc. It also operates a 7 Kilowatt Dynamo, generating electricity for lighting the grounds and residence.

Geared Windmills for Power Purposes.

The windmill constructed for pumping cannot be successfully applied to other work, because the motion obtained is a reciprocating, or an up-and-down one, whereas for power purposes, such as grinding, sawing, etc., a rotary one is required; to provide for such a motion, Geared Windmills are made.

The Geared Windmill is a machine that pre-eminently requires intelligence in its operation. This is not because it is complicated in itself, but because of the variable conditions under which it is called to do its work, and which have to be studied and learned before the greatest results can be secured with it.

We find, by the experience of our customers, that it takes them from six months to a year to learn how to manage their Geared Windmills and adjust them to their farm requirements, before they realize their indispensableness and value.

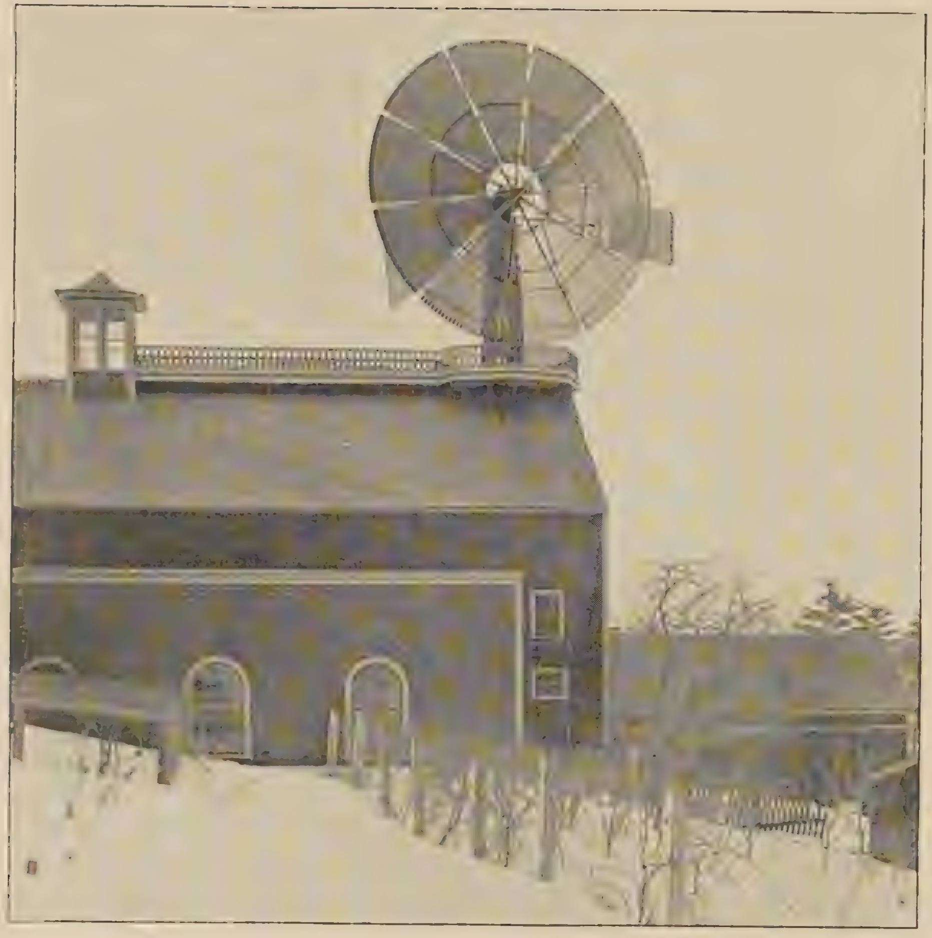
Our most enthusiastic testimonials come from men who have used our Geared Mills for a term of years, and who have the management of their mill studied out and adjusted to their work. Usually Geared Mills are bought simply for grinding purposes. It does not take an intelligent person long to learn that he can just as well attach a churn as not, and in a little while longer he will have his grindstone belted to the same power, and when it comes time to cut his year's supply of wood it will certainly occur to him that wind is the cheapest power to do the work. So the customer goes from one use to another, and before long he has learned to use his windmill for many purposes that were not originally thought of in his purchase of the mill, and which adds material advantage and profit to his investment in it.

It seems, therefore, that the first customers of Geared Windmills will be those progressive mechanical minds which we find in almost every community, who will develop the possibilities of wind power for their neighbors, as well as for their own satisfaction.

When this is done, others will follow their example, and before long the leading feature of every farm will be a Central Power Station with the Geared Mill for the motive machine. This will be capable of doing shelling, feed cutting, churning, pumping of the water, sawing of the wood, washing of the clothes and threshing of the grain. When such a method becomes general, it will dispense with a great deal of horse flesh that is now expensively kept for purposes on the farm that shall have been otherwise provided for, and a great deal of farm help, which is now an expensive yet necessary incident of our present methods, will be eliminated, to the profit and advantage of the farmer.

In all directions the severity of competition requires the elimination of all expensive methods of farming, and a careful accounting of the different ways and means by which the greatest product can be secured with the least outlay.

The general features which make the Geared Mill adapted to the new condition of the more intelligent farming of our time are first, that they furnish a power for the farmer that costs nothing for its original production: the wind is a universal power, everywhere present. Besides the cost of the Geared Mill, we have the cost of the tower upon which it is erected, and it is ready to be applied to grinding,



30-Foot Eclipse Geared Windmill on Farm Barn.

Erected on Estate of F. E. SIMPSON, Esq., Saxonville, Mass.

It was Erected in 1877, and has been in constant use since.

shelling, pumping water, churning, feed cutting, turning lathes and grindstones, and a variety of other purposes.

To do the same work by horse-power, whether sweep or tread, the cost of the horse-power, the price of the horses and harness must be taken into consideration; and the necessary shafting, pulleys and connections with which to connect to the machinery mentioned. In case of steam power the engines must be large enough to give the same power as the Geared Windmill. There also should be a boiler of sufficient capacity to generate the steam, with its water tank and pump, and other connections. Then there must be a building in which it can be kept, besides the shafting, pulleys and connections with which to connect with the machinery, to say nothing of the time taken to care for it, and the dust and ashes it makes.

Compare these first costs of equipping and connecting up the Geared Mill, the horse-power, and steam engine, for the several uses which farmers have to provide for, and the showing is materially to the advantage of the Geared Mill from the standpoint of economy. But when we come to the question of the cost of running these several machines, which is really the vital question as to their comparative economy on the farm, and the Geared Mill is conspicuously ahead of anything yet devised or known. It requires no attention or watching, or supervision when running; it is simply turned into the wind and left to itself.

The horses on a horse-power have to be hitched up and unhitched and kept going by a driver, if any satisfactory results are to be reached with them. Besides, the cost of the keeping of the horses, including the feed they eat and the care they require, makes a very palpable sum total to add to the cost of running farm machinery by horse-power.

The expense necessary to supervise and attend to the running of a horse-power, over and above what it costs to run a Geared Mill, will alone pay a large interest on the investment in said windmill. True, it is often said that farmers have to have horses, any way, and that the time when most of the grinding and feed cutting is done is in the winter, when the horses of the farm can be utilized for these purposes as well as not. To this it may be replied that the requirement of the farm in the way of feed cutting, grinding, pumping, churning, etc., continues all the year round, more or less, and if horse-power is to be used it must be available at all seasons of the year.

One of the reasons of the growing discouragement in the use of horse-power is, that the horses have to be utilized so severely during a large part of the year as to make it utterly impracticable to add to their burdens the power requirements of the farm. The result is that either special horses must be set apart for power purposes, or the grinding, shelling and feed cutting will be intermittent and ultimately abandoned. Horses cannot always, even in winter time, be used for power purposes, on account of the condition of the weather, or of the barn-yard where the horses have to travel in running the horse-power. Rain and mud, snow and sleet, and storm, are all against the successful use of horse-power for running machinery upon the farm. So far as steam is concerned, the cost of fuel is no inconsiderable amount for the purposes named, to say nothing about the increased fire risk which such a machine imposes upon the farm buildings.

20-Foot Eclipse Geared Windmill, on 75-Foot Tower.

Erected on Estate of GEO. E. McQUESTON, Esq., Marblehead Neck, Mass.

The Mill is used in connection with the Electric Lighting Outfit described later

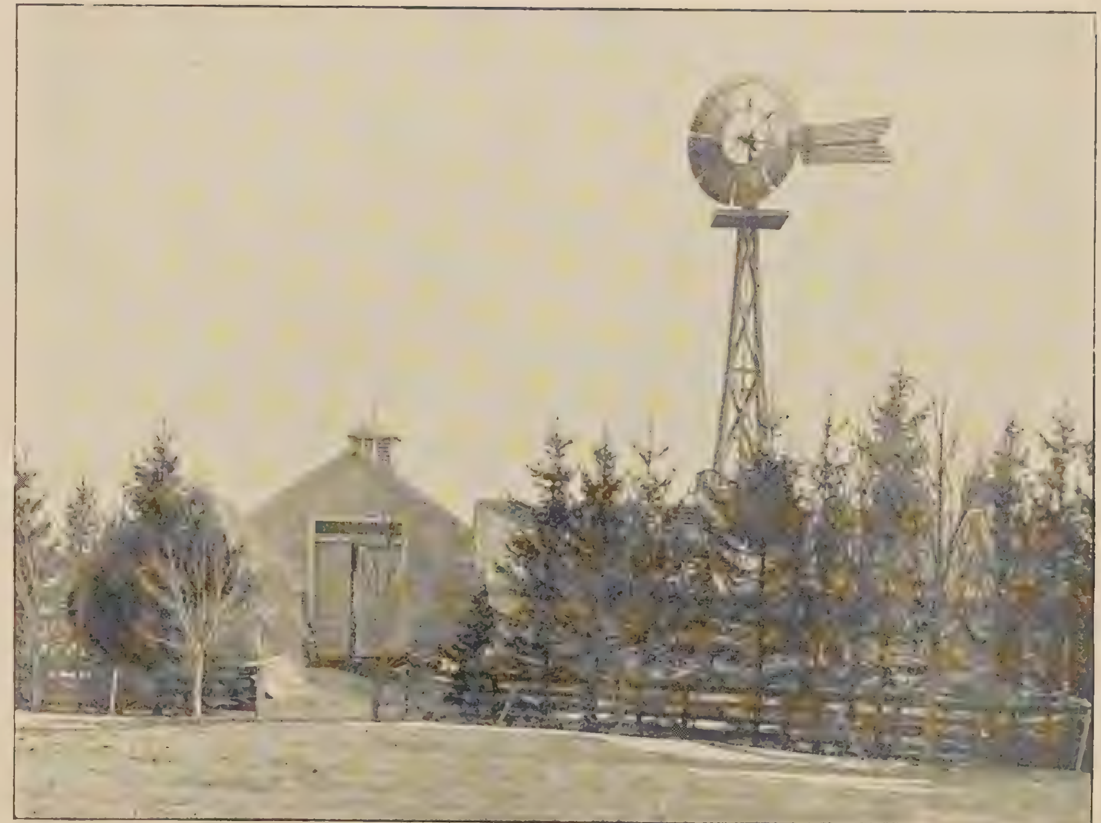
The Geared Mill has also the advantage of having self-tending devices connected with some of the machines used with it. The pump can be connected with float valves in the tank, so that the mill will shut itself off when the tank is full. The churn can be left to tumble away with a Geared Windmill with only an occasional inspection of the stage of the operation by the housewife. A good large hopper, holding fifty or one hundred bushels of grain, dispenses with the necessity of any attention from the farmer when grinding, for these grinders are so arranged that they can be left to themselves and will grind as well while the farmer is in the field or asleep as when he is present. And should the grinders become empty the plates are so arranged as not to suffer any injury from being left without any attention.

Thus it will be seen that from every consideration of the first cost of the plant, of the cost of securing motive power, or the cost of running these several machines, the Geared Mill stands pre-eminently as the machine for our times, among farmers who have entered into the work of progressive farming. Of course it will be said that the wind is intermittent and that the farmer is inconvenienced by not having his power from the windmill at all times when he wants it. Undoubtedly this is a disadvantage, but it is more so in appearance than in reality, for the reason that farmers can easily anticipate their wants, and do anticipate them with Geared Mills, so as to be forehanded with any work they are called to do. Even in the matter of ensilage cutting, where if would seem extremely necessary to have an abundance of power always ready for application, the windmill is likely to prove competent. But for all the other purposes of progressive farming, such as the pumping of an abundance of pure water for the use of stock and the cooling of milk, for the grinding of grain, for the cutting up of all kinds of fodder, for the threshing of grain, for the shelling of corn, for the sawing of wood, for the churning of cream, and even for running the washing machine, the Geared Mill has no competitor that is likely to come anywhere near its large margins of profit and advantage.

The propriety of calling windmills for power purposes "Geared Windmills," arises from the fact that the rotary motion of such mills is secured by gears. These gears connect the shaft of a windmill with an upright shaft running down to the bottom of the tower.

Thus, by means of sets of gears, the rotary motion of the wheel is communicated to a horizontal shaft which, in turn, by means of pulleys and belts, transmits a rotary motion to the machinery.

There are other methods of securing the rotation of the shaft than by use of gears. These devices consist of attachments to the reciprocating stroke of a pumping mill, by which the rotation of a shaft is secured. These devices have been variously called "walking beams," "power converters," etc., but have been so uniformly unsuccessful as to leave the Geared Windmill the exclusive title of being a Power Mill.



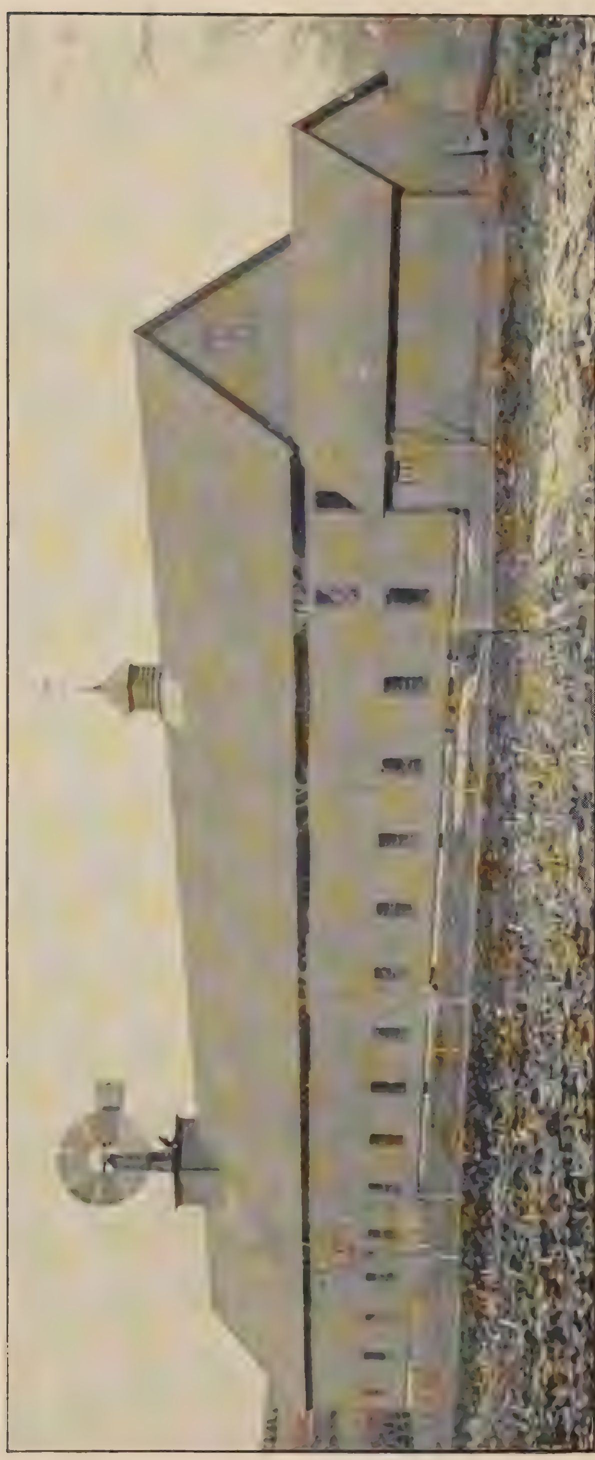
14-Foot Eclipse Geared Windmill, and Framed and Rodded Tower on Barn.

Erected on Stock Farm of Dr. H. M. HOWE, Bristol, R. I.

This Mill does all the power work incident to the requirements of a large farm, such as grinding grain, sawing wood, cutting ensilage, pumping water, etc.

Comparison of the Eclipse with other Geared Windmills.

There is a feature in the operation of the modern geared windmill that is peculiar to its principles of construction, and which is the direct cause of failure in its performance, in nearly every instance where it is subject to heavy strains in driving machinery. This defect is due to what is known by millwrights as "side-draft," or, technically speaking, the torsional or twisting strain of the gears upon each other. It will be noticed that the upper gear is attached through the wheel shaft, to the main casting of the windmill, while the upper pinion on the upright shaft is independent of the main casting, having a separate support on its shaft and the step bearing at the base of the tower. As the wind changes, the main casting with the upper gear attached, moves around on its pivot, or turntable, carrying the upper gear around the upper pinion, which cannot change its position on the upright shaft. It will be readily seen that the tendency of these gears, when the wheel is revolving, is to crowd away from each other, this strain is proportionate to the load, and is, of course, communicated to their respective bearings. The upper pinion having a fixed support, from which it cannot move, throws the whole torsional strain upon the upper gear, which, resting upon the main casting freely turning upon its pivot, accommodates itself to this strain by causing the main casting to turn upon the turntable, and the wheel is thrown part way out of its working position until it loses the force of the wind, when the torsional strain of the gears of course ceases, and the vane can then bring the wheel squarely to the wind. To overcome this serious defect has been the object of endless study and experiment, and has led to the adoption of all sorts of contrivances to offset the trouble, but it has remained for the Eclipse Mill to place the adjustment of the wheel to this disturbing feature in the hands of the operator, by the simplest possible means, without sacrificing in any essential degree the best mechanical arrangement of the working parts, or adopting makeshift and clumsy controlling devices. It will be noted in cut shown on page 86, that the vane on the Eclipse Mill shifts around to a position parallel with the wheel, and by the use of the reel H, this vane can be moved to a point determined by the exigencies of the work in hand, so that the torsional strain of the gears is offset by the shifting of the vane, from its normal position at right angles to the wheel to a lesser angle, or to the point where the wheel is kept squarely in the wind, the side shift of the vane exactly offsetting the side draft of the gears. Thus, in shelling corn in a light wind, the vane would be only slightly set off from a right angle; in grinding grain in a heavy wind, the vane would approach nearly an angle of forty-five degrees to obtain the best results. To accommodate this side shifting of the wheel we use a larger side vane on geared than on pumping mills, and obtain the full value of the wind simply by keeping our windmill wheel squarely to its work.



16-Foot Eclipse Geared Windmill.

Erected on Stock Farm of GEO. L. BRADLEY, Esq., Pomfret, Conn.

This Mill provides all the power required for grinding, feed-cutting, etc., for a large stock of cattle

In regard to other geared mills, those with the sectional or centrifugal mode of regulation, having their vanes fixed so that it cannot offset this side draft of the gears, ignore entirely this vital and important defect, and lay great stress upon the claim that because of centrifugal regulation they get a more even speed than otherwise is possible, trusting, perhaps, to their inquirer's ignorance of the axioms of mechanics to overlook the side draft of the gears. The actual performance of a so-called centrifugally regulated windmill cannot approach the results obtained by the best construction within fifty per cent; because they do not provide for this side draft. The fact is that these mills do not regulate so much by their boasted centrifugal principle as by the fact that their wheel sections are so pivoted that there is more surface exposed on one side of the pivot than on the other, and when the wind blows hard enough to lift the counteracting weight attached to the sections, they blow out. The heavy strains involved in power windmill work are very trying to all this complicated regulating apparatus in the sectional mills, necessitating repair and alteration, which is entirely eliminated in the Eclipse solid type of construction.

There is a modification of the sectional wheel geared windmill which is different from the type last under discussion, in that the vane is dispensed with, and two smaller wheels are used to guide the wheel into the wind. This involves the use of a complicated sectional wheel regulating arrangement for the mill, which does not permit the wheel to adjust itself to the varying wind currents as freely as is necessary to avoid heavy strains. The torsional strain of the gears necessitates the operation of the governing wheels almost continually in a heavy wind, involving wear and strain, which the light construction of this mill soon shows in a faulty response to its governing devices. A very annoying fault of this mill is its tendency to run its machines backward if the wind should come up, after a calm, in the opposite direction from which the mill was facing when it died down. This often results in serious damage, and its occurrence necessitates shutting down the mill and climbing the tower to turn the mill round upon its turntable by hand, a ridiculous performance for the owner of a self-regulating windmill.

The steel geared windmills now offered for sale make no provision for this side draft, and attempt by a plausible argument that a high-speed shaft has less torsional strain than one conveying the same power at a slower speed, to convince the trade that they have entirely obviated the difficulty. The loss in friction and the complication of gears necessary to obtain this result has been thoroughly weighed and determined upon in our own experiments, to be excessive, and claims to the contrary are evidence of ignorance or deliberate deception. A steel windmill, having broad fans and complicated gearing, cannot produce from a given wind pressure the power yielded by the simpler built, slow moving wooden wheel. The steel geared windmills are not at all to be compared with the Eclipse Wooden Windmill in construction, as they are much lighter and will not stand the strains brought upon them as well as the heavier parts of the Eclipse. As evidence of this, we present here the only testimonial we shall introduce in this catalogue.

LYNDEBORO, N. H., March 1, 1893.

Messrs. C. J. JAGER Co.,

No. 174 High St., Boston, Mass.

DEAR SIRS: — I have had in constant use, during the past fifteen months, one of your Eclipse 14-foot Geared windmills, and will say that it has never failed to regulate itself, and has stood the severe storms of the past two years without any damage. It pumps water from an Artesian well two hundred feet deep, and yields a never-failing supply of water for my house and barn. This mill takes the place of three 12-foot steel mills which were blown away, one after another, causing me serious loss and annoyance. This mill does more work, with less wear and tear than the steel mills, and it has stood through storms that would wreck the metal mills every time.

Yours truly,

CHAS. R. BOUTWELL.

What the Eclipse 14=Foot Geared Windmill will do.

This size is one of the most popular of our geared windmills for farm work, because its first cost is low, and the capacity of the machine is such as to meet the needs of the farmer. It will pump the water, saw the wood, cut feed, grind grain, run the churn and grindstone, and furnish power for general work on the average farm, to good advantage. Its capacity in sawing wood for family trade in a wood and coal yard has been shown to be three hundred cords a year, the windmill being used for no other purpose. It will grind from five hundred to seven hundred bushels of fine feed meal in a year's time; this is for fine feed; for coarse meal, its capacity would be very much greater.

The windmill of this size is best adapted to drive our No. 1 Grinder, but in especially favored locations the No. 2 A Grinder, having two speed pulleys, is used. The 14-foot windmill will operate our saw table with twenty-four-inch saw in heavy winds, but for general work it is not advisable to use larger than a twenty-inch saw. For "Details of Construction" of this size, see page 88.

16=Foot Geared Windmill.

The 16-foot Geared Windmill is a much heavier and stronger machine than the 14-foot size, and will do about one half as much more work. It will handle a twenty-four-inch saw on our saw table, and on a windy day cut up all the cord wood that can be got to the saw and away from it, up to ten inches in diameter. It is well adapted to run our No. 2 A Grinder, and in heavy winds will drive a twelve-inch Buhr stone grist-mill, giving the finest table meal.

20-Foot Geared Windmill.

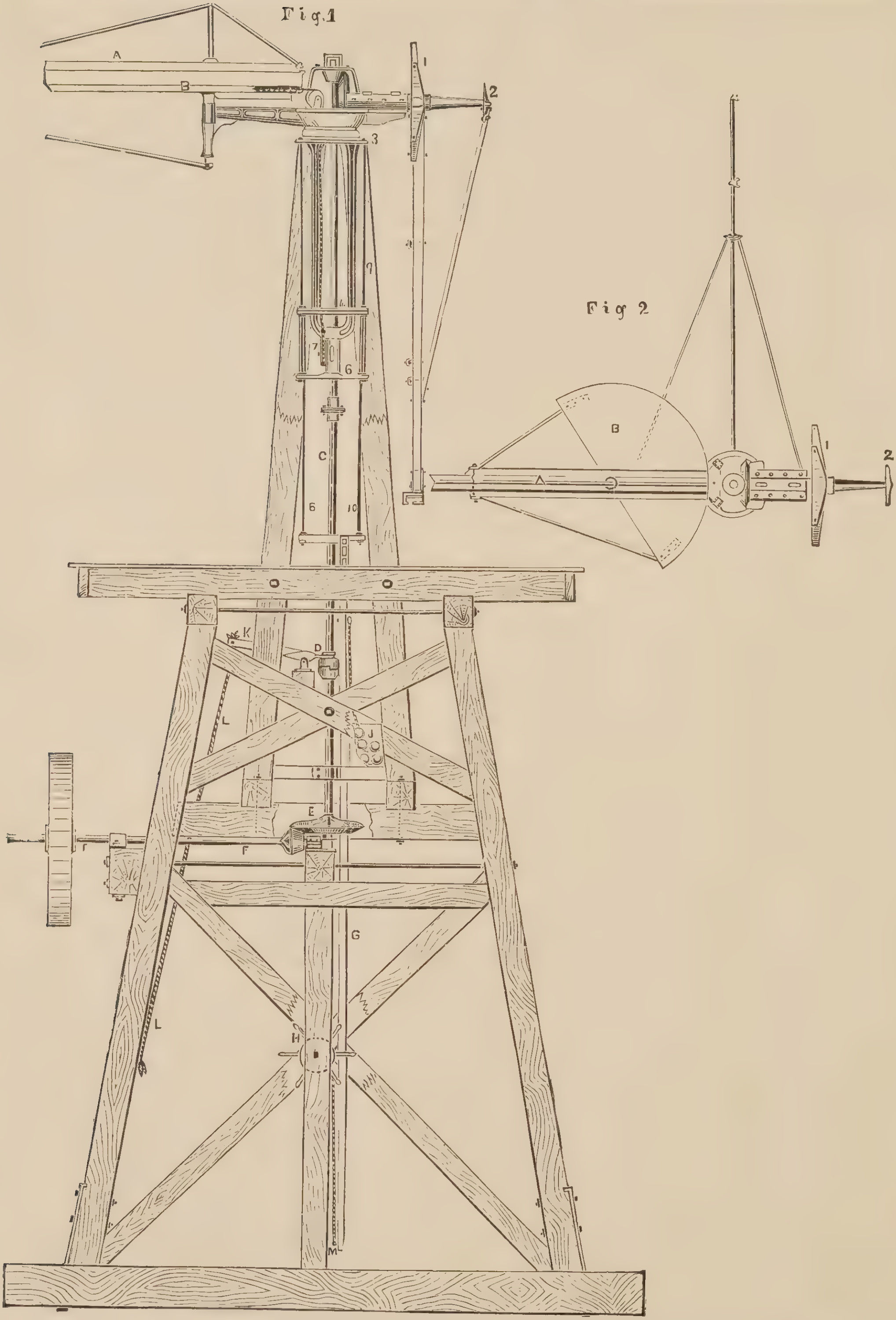
This size is popular with farmers who are specialists in the dairy business, as it will average forty bushels of feed meal a day during the winter months. It will also run the larger sizes of feed cutters, shellers, etc., with elevators, and has been used to run a threshing machine requiring three horse-tread power, this size being adapted to the mill in the average wind, its capacity in heavy winds being over five horse-power. In equipping this mill for grinding, we recommend two grinders, so arranged that either or both can be used at the same time. By this means the windmill can be used to run one only in light winds, while in heavy winds both can be attached, thus developing the full capacity of the mill in both light and heavy winds. We advise our No. 2 A Grinder in connection with a sixteen-inch Buhr stone as being well adapted to the capacity of a 20-foot windmill for a grinding outfit. We have this size mill running twenty-inch Buhr stones, but the above combination will give better average results.

Our 25 and 30-foot Geared Mills are proportionately more powerful than the smaller sizes, and with regard to their capacity and details of machinery to be driven, we invite inquiry, as these larger sizes of mills are generally used for special purposes, requiring special machinery.

Construction of the Eclipse Geared Windmills.

The cut on page 86 shows the details of construction of the Eclipse Geared Windmill in sizes from sixteen to thirty feet in diameter. The tower shown in elevation in Fig. 1 is not represented as being suitable for actual service, but merely to exhibit the working parts of the windmill and shafting in position. Fig. 2 gives a plan view of the mill, showing wheel shaft and main and side vane attached to the main casting.

The Eclipse Geared Mill is built upon one very heavy central casting, which supports the wheel, vanes and upper gears, and extends down into the tower to the pivot step No. 6, resting there upon a hardened steel ring, on which it turns to meet the wind. This construction places all the upper working parts upon one bed or foundation casting; they are rigidly supported, and the swaying, straining or settling of the tower from any cause cannot affect their alignment with each other. The extension of the main casting down into the tower avoids the rocking of the machine on the tower, so disastrous to geared windmills having only a circular ring on the top of the tower posts for a support. There are broad, flat bearings on the tower cap at the head of the posts, and on hardened steel turntable, or pivot step; these have been proportioned to make the mills exceedingly sensitive to the varying directions of the wind currents, and are very durable; the rollers and balls used in other mills at these points become worse than useless in a very short time, because widely varying strains cause them to wear very unevenly; in this condition they impede the movement of the mill upon the turntable, to its consequent strain and injury in high winds.



Details of Construction of the Larger Eclipse Geared Windmills.

The upper gears in the 16, 18 and 20-foot mills are made of cast steel, twice as strong and four times as durable as cast iron, and are enclosed in a dome-shaped casting to give them a firm support and protection from sleet and ice. The shafting is finished, the couplings and gears are keyed to the shaft, and the machine work is standard in every respect. The boxes are babbitted, and the lower end of the upright shaft runs on a hardened step, immersed in oil, making a very durable arrangement. The lower gears are machine cut and therefore fit perfectly and run smoothly, a feature possessed by no other geared windmill offered for sale: their first cost is something more than a cast gear, but they are well worth the difference. The main vane and side vane are firmly supported on the main casting, and we have never known one of these vanes to be lost because of weakness in their attachment to the mill. They are trussed in every direction from which strain may come, and will stand long and hard service. The woodwork of the wheel and vane is made up of selected material put together in the strongest possible manner, the whole combination making the windmill superior to any we have seen in a long acquaintance in the field. The details of the 25 and 30-foot Geared Mills are similar, with the exception of having cast gears only, these being so large that their wearing surface can be readily dressed to provide for slight inequalities in casting. The details of the 14-foot Geared Mill are shown on following page.

The method of regulation in the Eclipse Geared Mill is substantially the same as in the pumping mill, being as follows, reference being made to parts shown in opposite cut. When mill is in use it is regulated by the pressure of the wind on the side-vane; this, in heavy winds or gusts, carries the wheel more or less out of the wind. In doing this it raises the shut-off pole G, to which are attached regulating weights J, by means of chain passing around circle board B, thus lifting balls or weights out of box, and throwing the weight on shut-off pole G. This acts as a counter-weight or balance to the side vane, and as the wind slackens, these weights bring the wheel back, facing the wind again. When it is desired to stop the mill, wind up the chain on reel H, thus raising up the shut-off pole G, and through chains on circle-board B, throwing the wheel around edge to the wind. For the convenience of the operator a clutch coupling D is placed on the upright shaft, operated by lever K and rope L, so that the machinery can be stopped at will, without shutting off the windmill, a special feature in the Eclipse not possessed by other mills.

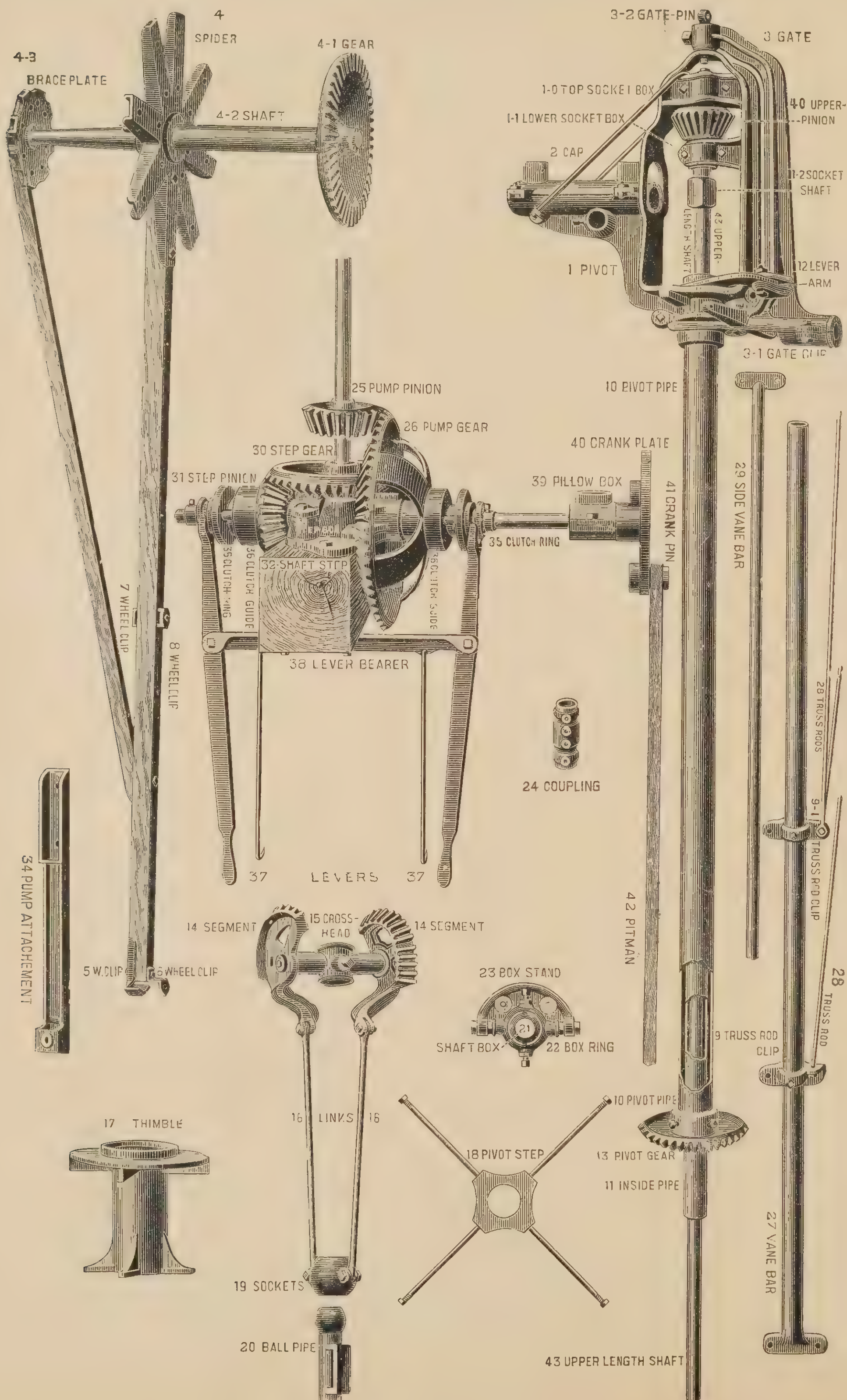
PRICE LIST OF ECLIPSE GEARED WINDMILLS.

Diameter.	Horse-Power.	Weight.	Size of Upright Shaft.	Price.
14 Feet.	$1\frac{1}{2}$	1,600 Lbs.	$1\frac{1}{4}$ Inches.	$200.00
16 "	$2\frac{1}{2}$	2,500 "	$1\frac{7}{16}$ "	315.00
18 "	3	2,700 "	$1\frac{7}{16}$ "	360.00
20 "	5	4,000 "	$1\frac{5}{8}$ "	440.00
25 "	7	5,600 "	$1\frac{15}{16}$ "	650.00
30 "	9	9,500 "	$2\frac{1}{4}$ "	975.00

This price includes all shafting, upper and lower gears, with 12-foot line shaft, boxes and bolts for same, for 40-foot tower.

For table showing the horse-power of the different sizes, in varying winds, see page 90.

Details of Construction of 14-Foot Eclipse Geared Windmill.



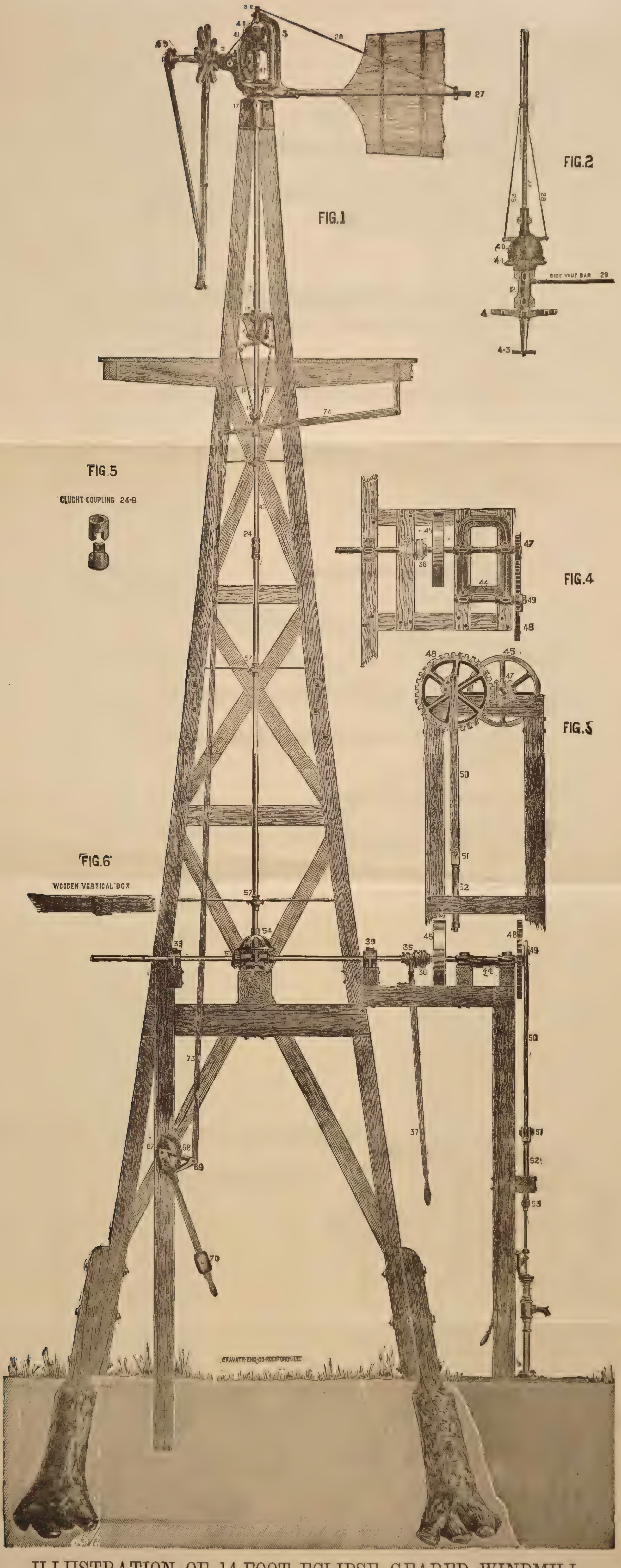
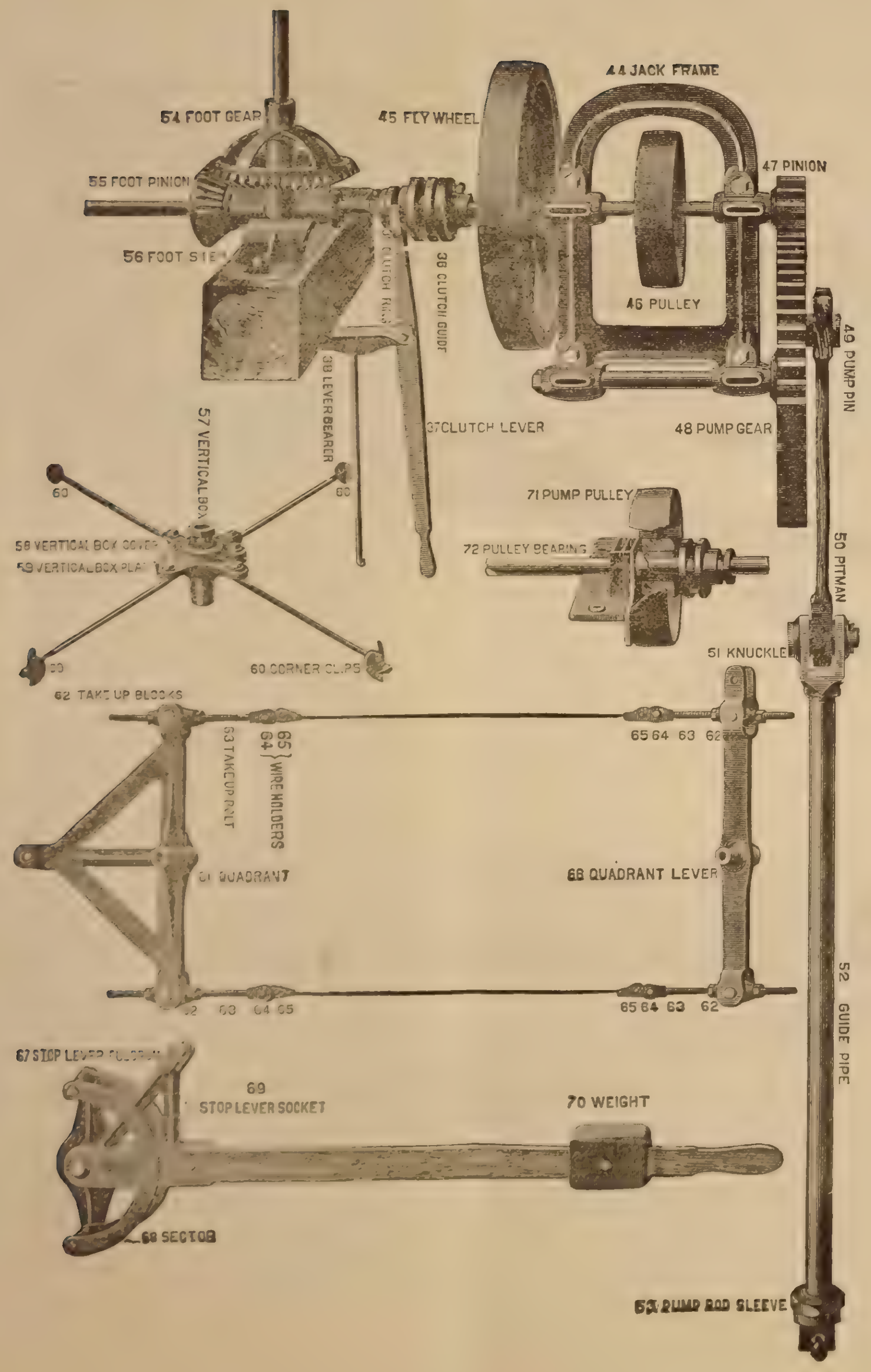


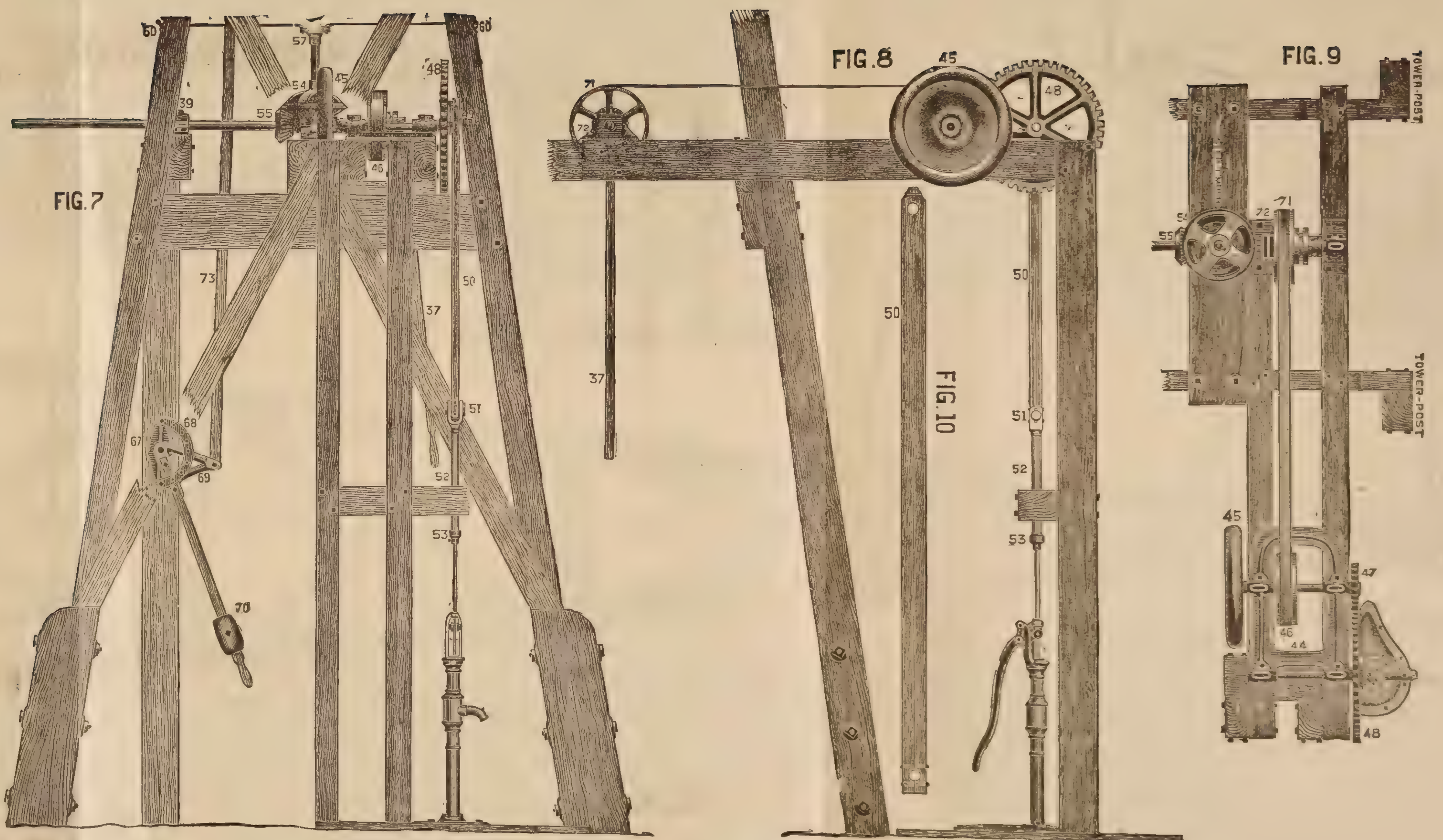
ILLUSTRATION OF 14-FOOT ECLIPSE GEARED WINDMILL.

Fig. 1 shows the upright shafting with a section of the horizontal shafting on one side and a Pump Jack on the other.

Fig. 2. A plan view of the Mill.

Figs. 3 and 4, and also 7, 8 and 9, (on other side) cuts of the Pump Jack.



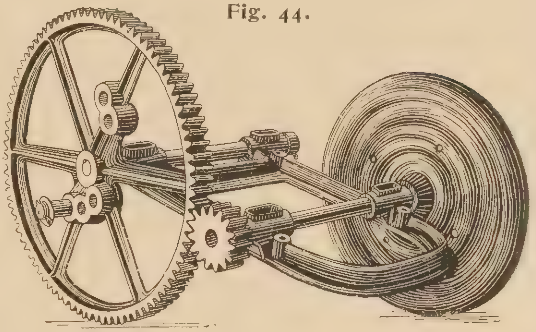


PUMPING JACK, SHOWING BELT CONNECTION.

The Eclipse Pump Jack.

A pump cannot be attached directly to a geared windmill, and to make this connection calls for the use of a Pump Jack. Fig. 44 shows that which we have for this purpose, adapted to any windmill pump. This can be operated in any position, and driven by a belt or direct shaft connection. It is back-geared 6 to 1, and fitted for five, six, eight, ten and twelve-inch strokes.

Fig. 44.



PRICE, $24.00.

Illustrations of the practical working of this jack will be found on the folder.

The Proper Equipment of Geared Windmills.

No farm machine is more dependent for its success upon its proper adjustments than is the Geared Windmill. This arises principally from the great variety of uses to which it is applied, and the variable conditions of the wind, which have to be provided for in its equipment. Hence the need of a thorough understanding of the general principles which should guide in the selection and furnishing of these mills. First:—They must have sufficient power to do their work in average winds. Mills that can do their work well only in high winds may yet be comparatively useless, as such winds do not prevail more than a twelfth of the time, and as the power of the wind is as the square of its velocity, the effect of the stronger winds is no safe criterion by which to judge of their average force. Thus it happens that mills that are estimated from their results in good winds, prove utterly worthless in ordinary, average conditions. The average wind may be put down roughly at about eleven miles an hour. Power mills, to be successful and profitable in every way, ought to have the power to operate almost any one of the machines to which they may be applied in such a velocity of wind: here it must be remembered that machinery is usually driven at high speed, while the windmill itself runs very slowly, and it must have wheel surface enough to furnish power under these conditions.

They should be easily managed, and equipped with self-tending devices. Most of these windmills are designed for farm use where professional talent would be too expensive, even if available, and must, therefore, be so simple and reliable in

their operation as to be perfectly safe under the supervision of ordinary farm help. But even this supervision will prove too expensive if too much of it has to be employed in operating the mills. The intermittent character of the wind will not allow of any farmer spending too much time in waiting on its uncertain movements, and hence the necessity of automatic devices, whereby the mill can do a good share of its work without attention of any kind: with these a farmer may go to his field to work, and even retire for the night, and feel that his work will be equally well done without his presence. The sum total of the work a mill will do when thus equipped is very much larger than is usually supposed possible. Testimonials as to the work of these mills will be sent on application.

The mills must be connected with machines specially adapted to them, to work economically and successfully. Since wind power is a variable force, it is necessary that some recognition should be given this fact in the machines that are operated by it. To put on the mill a style and size of machine appropriated to its highest speed, would overload it for its ordinary motion. It is generally best to adjust the work to be done to the slower speeds of the wheel, and while this method will not allow of the highest maximum results in brisk winds, it will assure a greater average, as it will allow the mill to work most of the time.

The present equipment of the Eclipse Power Mills has been the result of following closely the above requirements.

We make no smaller Power Mills than 14-foot diameter of wheel: they range from that upwards to sixty feet in diameter.

We are often asked why the smaller mills, which give such power for pumping purposes, could not be applied to machinery with equally satisfactory results. We answer this question by calling attention to the fact that the mechanism requisite to secure rotary motion introduces a great deal of friction. The friction consumes a large portion of the power of a small geared mill, and leaves little or no power wherewith to do the work. Our own judgment, therefore, is that a 14-foot mill is the smallest size that will overcome the extra friction of power work and yield a profitable residuum of force with which to run machinery.

We submit herewith a table showing the power that may be had from Geared Windmills, under average conditions, in suitable locations.

ACTUAL, USEFUL HORSE-POWER, DEVELOPED IN WINDS OF STATED VELOCITY PER HOUR.

Diameter of Wheel.	10 Miles.	12 Miles.	16 Miles.	20 Miles.	25 Miles.	30 Miles.
14 Feet.	$\frac{1}{4}$	$\frac{1}{2}$	1	$1\frac{3}{4}$	$2\frac{1}{2}$	3
16 "	$\frac{3}{8}$	$\frac{3}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$3\frac{1}{4}$	4
18 "	$\frac{3}{4}$	$1\frac{1}{4}$	2	3	4	5
20 "	$1\frac{1}{4}$	2	3	4	$5\frac{1}{2}$	7
25 "	$1\frac{3}{4}$	3	$4\frac{1}{2}$	6	8	10
30 "	3	4	$5\frac{1}{2}$	7	9	12

This table gives the results obtained by windmills used in connection with dynamos for generating electricity, in which work a perfectly accurate and scientific measurement is taken. The usual ratings of the power of windmills are based on a wind velocity of eighteen or twenty miles per hour, while the average wind is but eleven miles, and all tables of this kind that we have seen, give the power from twenty to fifty per cent. higher than it is possible to produce.

Suggestions Regarding the Proper Location of Geared Wind=mills, with Reference to Their Several Uses.

Always place the windmill where it will be high above surrounding wind obstructions. One perplexing question that confronts a customer who has made up his mind to buy a Geared Windmill is, where to locate it, and just the form of connection to drive the several machines which he wishes to operate by means of it. Unless there are special reasons to the contrary, the following directions will be helpful: First locate your windmill nearest the place you want your grinding done. This is on the principle that all machinery should be nearest its heaviest work. Grinding is ordinarily the severest tax of any of the uses to which it is put, hence the closer the mill to the grinder, the better, as a rule, for the success of the mill. The connection to the other machinery can be made in a very satisfactory manner by shafting or belting, for ordinary demands, and for special service there are a number of devices which we can suggest that will enable general work to be handled very nicely with a windmill. The pumping of water, sawing wood, cutting feed and grinding grain is easily provided for in most cases with a Geared Mill having very compact shafting arrangements, but it sometimes happens that a rope connection can be made, carrying power a long distance to good advantage.

It is sometimes suggested that a Geared Mill, for farm use, is placed to best advantage on the barn, and we are inclined to favor this where this can be done without interference with the best working of the machinery. If, however, the windmill is in any way placed at a disadvantage in locating it on a building, either from an unfavorable wind exposure, or complicated shafting connections, it is poor policy to choose to do so rather than build a suitable tower for it, as the difference in the cost of placing a Geared Mill on a tower or on a building is not always in favor of the latter. In building a tower, the best results are obtained from the greatest heights, without any exceptions, and in our opinion a Geared Windmill should not be erected on a tower less than sixty feet high, even in the most exposed situations. A vital point in connection with a Geared Windmill is that the machinery to be driven by it should be adapted for the purpose, and we show machines that have been especially designed for windmill work, which we confidently recommend as being the best that can be had.

20-Foot Eclipse Geared Windmill, on 75-Foot Tower.

Erected for GEO. E. McQUESTEN, Esq., at Marblehead Neck, Mass.

This Windmill takes the place of an 8 H.-P. steam engine and boiler in generating electricity for lighting the two houses and buildings; as shown, these are equipped with 137 lamps of 16 candle power each.

Windmill Electric Lighting Plants.

The combination of a windmill and dynamo for generating electricity has been a subject of intense interest and very close study for years past, and it is only recently that electrical appliances have been perfected so that they could be used to good advantage in connection with a windmill. The varying speeds of a windmill wheel are provided for by special dynamo construction, and the perfection to which the electric storage battery has been brought makes it a very simple matter to store the energy of the plant until it is wanted. In the development of this combination of the windmill, dynamo and storage battery to its present successful status, it was found that only the very best construction in the details of the windmill itself could be used, owing to the exacting requirements of electrical work, and we have made the Eclipse as thoroughly complete for its duty as is possible. We shall be pleased to submit estimates of cost of complete lighting plants to any one who may desire the same, on receipt of their statement, showing the number of lights required, the average number of lights to be burned at one time, the average number of hours lights are to be used, and the distance of windmill location to centre of distribution. We give below, by permission of our customer, the substance of an article from the *Electrical Engineer*, of November 21, 1894, describing one of our outfits recently erected at Marblehead, Mass.

The Windmill Electric Lighting Plant at Marblehead Neck, Mass.

"The desire by many owners of country houses to light them in a manner fairly comparable with that of their town houses, has brought forth an endless variety of methods, involving gas in one form or another. But quite recently the matter has been approached from another standpoint, namely, that of the windmill in connection with the storage battery. In order to show that this method is not only practicable, but economical, not to mention its other advantages, we give a description of a windmill electric lighting plant erected by Mr. Geo. E. McQuesten, of Boston, at the family country seat, at Marblehead Neck, Mass.

There was no public system of lighting at Marblehead Neck (a summer resort), and hence private plants had to be resorted to. In the spring of 1892, Mr. McQuesten put in a small electric light plant, consisting of a boiler, 8 horse-power engine, 3-Kw. dynamo, and a set of forty-six cells of storage battery, having 140 ampere-hour capacity. This plant was put in the stable, and cost, complete, $1,000, supplying lights to the house and stable. The batteries were charged once a week, either by the proprietor or by the gardener, after he had been taught to run the plant. The necessity of economizing on the use of light was felt, however, and so, except on special occasions, not more than about 100 ampere-hours a week was used in the summer time. Later in the fall the batteries had to be charged twice a week. This plant was run winter and summer; in the winter the lights were used by the caretaker, but it was found to be a matter of some inconvenience to take the gardener's time for charging the batteries in the summer season, when his other duties were of equal importance, and to meet this difficulty, and save the cost of operating the steam plant, Mr. McQuesten put in a windmill outfit, equipped

with automatic regulators and self-tending devices, arranged to run and charge the batteries without special attention from any one. This was completed on May 1st, and has worked well ever since. The outfit is illustrated on page 92, and consists of a 20-foot Eclipse Windmill, mounted on a tower seventy-five feet high to centre of wheel from the ground. Power is transmitted through bevel gears and one and five-eighths inch shafting, to the house built at the base of the tower, which is eighteen feet six inches square at that point. At the same time a larger set of batteries was installed, so that another house could be supplied with light, the old set being in good condition, but were not of sufficient capacity. The dynamo is a 3-Kw. Lewis machine, but ought to be 4 or 5-Kw., as the windmill develops more power than was anticipated. This charges the battery, consisting of forty-six Bradbury-Stone storage cells of 200 ampere-hour capacity. Ninety-volt lamps are used, and an automatic switch closes the circuit between dynamo and storage batteries, when the potential of the dynamo rises to the required voltage and breaks the circuit when the current stops flowing into the batteries.

Our engraving shows, on the left, the house and stable of Mrs. McQuesten; the dwelling house on the right is owned by General Elbert Wheeler, of Nashua, N. H. The house next to the windmill tower is Mr. McQuesten's workshop, and contains tools and machinery of all kinds, for experimental work. The house enclosed within the base of the tower contains the entire electric light plant, as well as all the gardener's tool and implements. The McQuesten house contains sixty lamps, and the other fifty, the stable fifteen, and the workshop and tower about twelve. During the shortest evenings about forty lamp-hours per evening were used, all told. This was not very much, it is true, but was all that was needed. The amount increased gradually, until on November 1, ninety lamp-hours per evening were consumed. At times, when there was plenty of wind, the shop was run by an electric motor from the batteries, and in October the motor was used altogether whenever the shop was run.

The windmill furnished all the above lights from May 1 to November 5, when the houses were closed for the winter. A ten-mile breeze gives from three to five amperes, at one hundred and ten volts, while a twenty-mile wind gives eighteen to twenty-five amperes at one hundred and ten to one hundred and twelve volts. It has not been possible to store all the power developed in a wind of above twenty miles velocity.

The dynamo is provided with a series coil on the field, wound differentially to the shunt, so that the machine delivers current at constant potential, at variable speeds. Mr. McQuesten tried the experiment of cutting out the differential winding and running the dynamo as a simple shunt-wound machine. It worked beautifully in light winds, for as the wind increased, the tendency of the wheel to revolve too fast was checked by the increasing load on the dynamo, thus maintaining a practically constant speed, and the greatest possible efficiency. This was very satisfactory until the force of the wind increased so that the windmill delivered to the dynamo more power than it could safely take care of, and so would have been injured if left running, clearly demonstrating the advantage of differential winding, which allows the dynamo to run at high speed without danger of overloading."

Mr. McQuesten's plant has proved so satisfactory that the outfit shown on page 74 has also been equipped with electrical apparatus for the same purpose.

Qualities and Characteristics Required in a Grinder for Wind=mill Purposes.

We have already stated as a general principle in selecting machines to be run with geared mills, that they must be specially adapted to the peculiar conditions of wind power. This is pre-eminently true of the Grinder. Most of the iron grinders made have their buhrs so shaped that when they stop, the grain wedges in the plates and the whole machinery is locked thereby, and it takes a great deal more power to start it than is required to run the machine. The result is that when these grinders are used in connection with windmills, they very seriously embarrass the success of grinding by wind power, for when the wind dies down so that the windmill stops, the locking of the plates by the wedging of the grain prevents the windmill from starting up again unless assisted by hand. In other words, those grinders that lock and wedge when they stop, make it impossible to carry out the plan of leaving the windmill to do its work without supervision.

This result has in times past operated to deprive wind power of its leading advantage over other motors in this line. The Eclipse Grinders are so made that there is no wedging of the grain in the plates when the mill stops, and it is perfectly free to start up easily again, whenever the impulse of the wind revives enough to run the windmill at all. With our machine, all the grinding of the farm, or even of the miller, may be left to be done by the mill automatically, without any supervision, and the farmer can be perfectly sure of a large average grist under any conditions of the wind that will turn a grinder at all.

In adjusting the speed of the grinder to the windmill, it should be slow enough so that in very light winds the mill will do a little something, and even though this little may seem trifling and insignificant, as long as the mill does not have to be watched or any time spent upon it, it can be left to accumulate by small amounts the pile of feed, until it reaches a large sum total.

In the same way the self-feed appliances need to be simple. The regular feed devices of grinders which are made for use with horse or steam power, are altogether out of place with Geared Mills. The variable speed of the windmill makes it impossible for these self-feed devices to be of any special value. The best way is to construct a grinder so that its worm feed cannot overload the machine. The characteristics of the Eclipse Grinders make them equally serviceable for tread or horse-power machines.

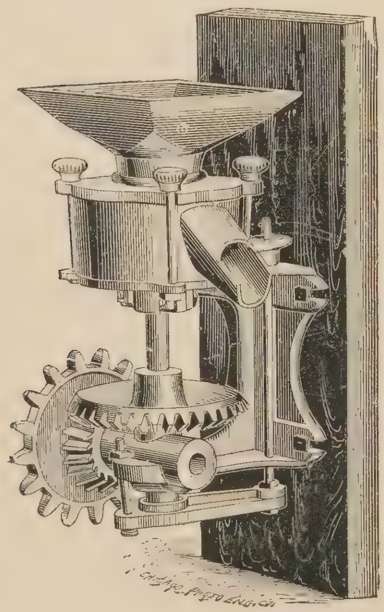
Horse-power is more or less variable, and to use it economically in grinding, it must be relieved from the locking tendency above mentioned to enable one to use it successfully. With the Eclipse Grinder, a man is free from any attention to the grinder, and can spend his time in feeding and sacking the grist and keeping the horses in motion; the absence of wedging or locking does away with any tendency to heat the meal or the grist that is ground. We have not aimed

to secure the maximum capacity of our machines under forced conditions; nor have we attempted to obtain the finest possible quality of grist from our plates; our aim has been to provide a grinder that would produce the quality of grist required for the average stock feeding, with the least power, with no wedging of the plates or heating of the meal. For those who require the finest kind of meal we furnish special plates that will secure the result. We therefore request, in this connection, that those who make inquiry about a grinder, should be particular to specify whether they want very fine grinding, or whether their requirement is average stock feed.

Eclipse Grinders. Suitable for Steam or Horse-Power, but especially designed for Windmill Work.

We have devoted considerable time and expense to devise satisfactory grinders for windmill use. The grinders offered by manufacturers of these goods were not provided with the special features to meet our requirements, although they were fairly suitable for steam or horse-power. The ordinary grinder must be driven at a high and constant speed to get good results; in the Eclipse we produce a well-ground feed meal at the slowest speed, and the very best quality at high speed, obviating the wedging of the grain in the plates when the mill stops.

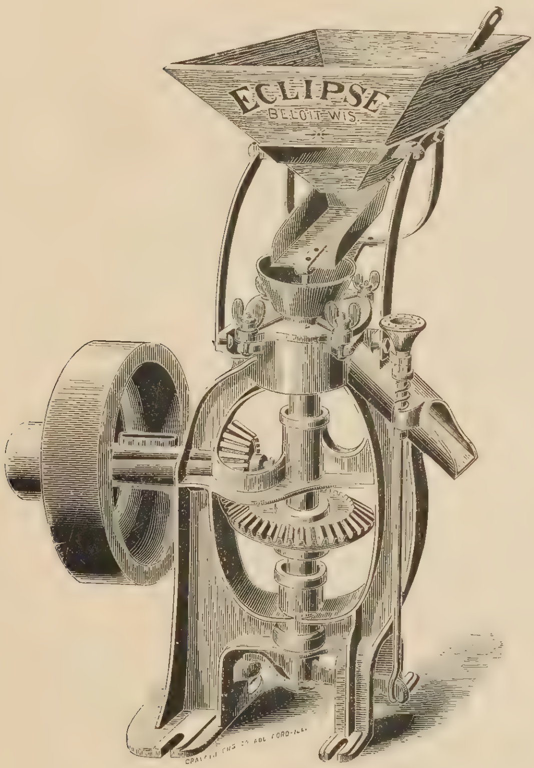
The grinding rings, or plates, are made of chilled metal especially for our machines, and will grind from six hundred to one thousand bushels of grain, according to the fineness of the meal, and can be replaced at small expense. They can be placed in position to get the best results by any one; the grinders are so built that it does not require special skill to adjust them to their work. The under plate is moved up to its work by a screw feed which can be locked when it is set, thus maintaining an even quality of meal. The running plate is the lower one, so that if the grinder is left running empty, no damage can be done to the plates.


No. 1 Eclipse Grinder.

We make two grades of grinding rings, one for ordinary and one for very fine grinding, the ordinary ring meeting practically every requirement. The grinders will handle any substance that can be gotten into the plates, and we have very successfully ground gum arabic with our No. 2 A Grinder. Their work on whole corn and cob meal is unsurpassed, the ears having first been crushed to the size of the

whole grain. In their design we have embodied symmetry and strength of construction, with every adjustment that will meet the convenience of the operator. Our No. 1 Eclipse Grinder is arranged to run with a sprocket chain No. 52, or with a 4 x 12 pulley for belt. It is built to be fastened against the side of its support, and the pulley shaft can be changed from one side to the other if the location demands it. It is a first-class low-priced grinder. Capacity at one hundred to three hundred revolutions of pulley shaft, one to four bushels per hour, according to quality of meal.

PRICE - - - - - - - - - - $25.00.



Our No. 2 A Eclipse Grinder is designed for use where large quantities of meal are required for feed, and is a superior machine in every respect. It is arranged with cone pulley, sizes respectively 4 x 7½ and 4 x 15 inches, and at six hundred to one thousand revolutions of the pulley shaft per minute will produce from six to fifteen bushels of meal per hour, according to the quality of the meal ground.

This grinder will give excellent result with steam or horse-power, its adjustment for the varying speed of windmill power rendering it exceptionally well adapted for general grinding purposes.

PRICE - - - $45.00.

With matched cone pulley for countershaft - $48.00.

Price of extra grinding plates, per pair - - $1.50.

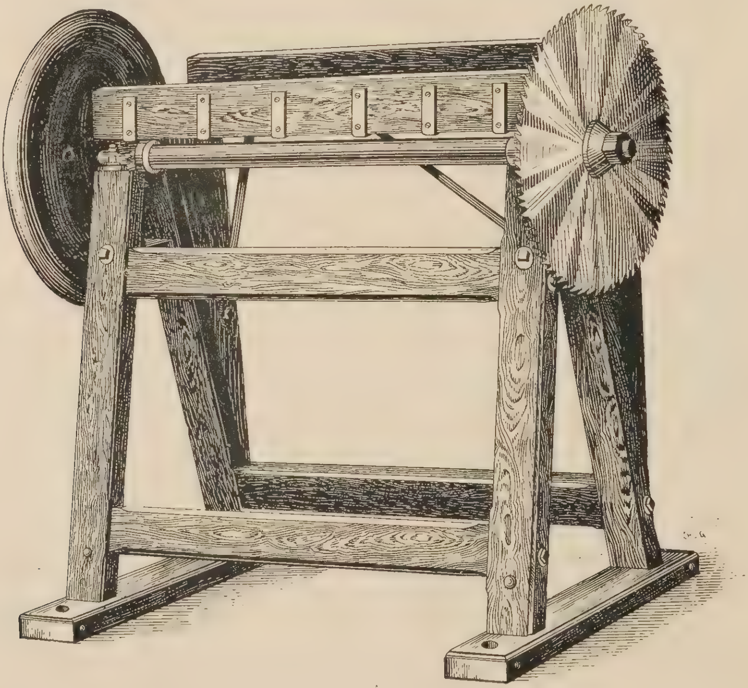
Eclipse Saw Table.

We have found it necessary to make a special saw table for our windmills, as the construction of the ordinary article is faulty in its shaft and bearings. The frame of our table is solidly made of hard wood, bound together in a thorough manner. The swinging frame which receives the wood is heavily ironed, and will stand hard usuage. We prefer a swinging to a sliding table, because it is easier to

handle and the hands of the operator are away from the saw while the wood is being changed for a new cut. The shaft is made very heavy, two-inch diameter; this, in many other tables, is only one and one-quarter inch in diameter. The bearings are babbitted and are adjustable to wear, and having projections at right angles to their length, which fit into grooves in the shaft, the end play of the shaft is carefully provided for. This makes the Eclipse saw table a durable and safe machine to operate, since the end play of the shaft, due to ordinary wear, is provided for, a lack of which in any saw table is likely to result in injury to the operator.

Pulley is five-inch diameter for four-inch belt. Speed, six hundred to nine hundred revolutions a minute.

Eclipse Saw Table. Complete with Saw.



Price, including 24-inch Saw, 45.00.

PRICE LIST OF ECLIPSE JUNIOR WINDMILLS.

Diameter.	Shipping Weight.	Price.
6 Feet.	200 Lbs.	$25.00
$8\frac{1}{2}$ "	280 "	35.00
10 "	400 "	45.00
12 "	600 "	60.00

FAIRBANKS 8-FOOT GALVANIZED STEEL WINDMILL. PRICE, $30.00.

PRICE LIST OF ECLIPSE PUMPING WINDMILLS.

Diameter.	Shipping Weight.	Price.
10 Feet.	510 Lbs.	$ 75.00
12 "	670 "	100.00
14 "	1,100 "	165.00

PRICE LIST OF THE ECLIPSE RAILROAD PUMPING WINDMILLS.

Diameter.	Shipping Weight.	Length of Stroke.	Price.
16 Feet.	1,650 Lbs.	6 and 8 Inches.	$280.00
18 "	1,875 "	6 " 8 "	325.00
20 "	2,835 "	7, 8 " 10 "	450.00
25 "	5,000 "	12, 14 " 16 "	625.00
30 "	8,500 "	12, 14 " 15 "	900.00

PRICE LIST OF ECLIPSE GEARED WINDMILLS.

Diameter.	Horse-Power.	Weight.	Size of Upright Shaft.	Price.
14 Feet.	$1\frac{3}{4}$	1,600 Lbs.	$1\frac{1}{4}$ Inches.	$200.00
16 "	$2\frac{1}{2}$	2,500 "	$1\frac{7}{16}$ "	315.00
18 "	3	2,700 "	$1\frac{7}{16}$ "	360.00
20 "	5	4,000 "	$1\frac{5}{8}$ "	440.00
25 "	7	5,600 "	$1\frac{15}{16}$ "	650.00
30 "	9	9,500 "	$2\frac{1}{4}$ "	975.00

PRICE LIST OF FAIRBANKS STEEL TOWERS.

Painted.

Height.	Shipping Weight.	Price.
30 Feet.	500 Lbs.	$25.00
35 "	590 "	30.50
40 "	700 "	36.00
50 "	930 "	45.50
60 "	1,220 "	60.00

Galvanized.

Height.	Shipping Weight.	Price.
30 Feet.	520 Lbs.	$33.50
35 "	600 "	38.00
40 "	720 "	43.50
50 "	970 "	59.00
60 "	1,270 "	74.00

These prices include GALVANIZED ANCHOR POSTS for either painted or galvanized towers.

Price List of Repairs for Eclipse Windmills.

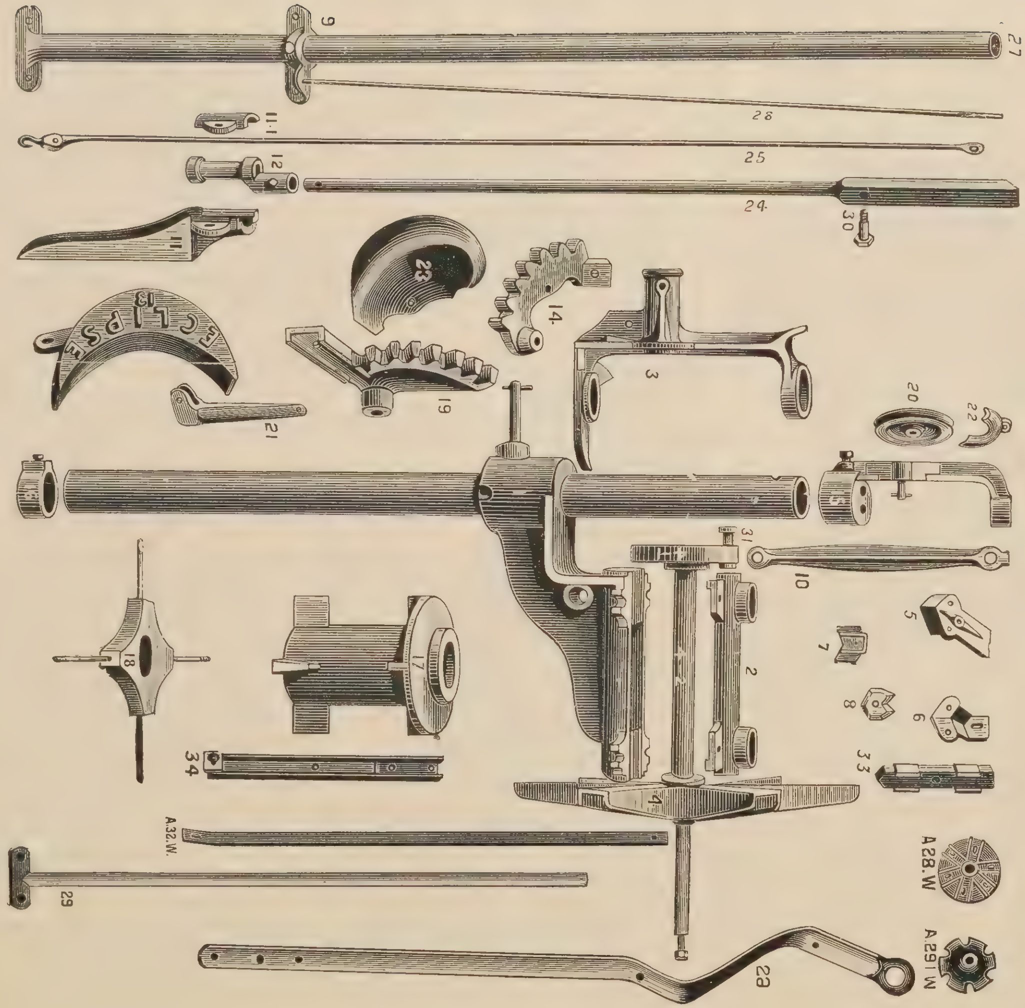
In ordering Repairs, always mention the number of casting, its name, and the size of the mill for which it is wanted.

Wrought iron parts of the mill are not numbered, but can be easily distinguished by referring to the cut, where a number is given them.

In all cases Repairs will be sent C.O.D., unless money is forwarded with the order, which can be done, as the price is distinctly stated below; you can therefore save return charges upon it by sending the money at the time of the order.

This table should be preserved carefully, as by it you can order by telegraph or letter just what is wanted when the mill needs it.

No.	NAME.	PRICE. 8½ ft. mill.	10 ft. mill.	12 ft. mill.	14 ft. mill.
1	Pivot	$6.50	$8.50	$9.75	$15.00
2	Pivot Cap	.85	1.00	1.25	1.90
3	Gate	2.25	3.00	3.75	5.50
4	Spider	2.50	4.00	4.75	7.00
4–1	Face Plate	1.00	1.25	1.50	2.25
4–2	Shaft	1.10	1.25	1.50	2.25
5	Clip	.20	.25	.35	.50
6	Clip	.15	.20	.25	.35
7	Clip	.10	.15	.20	.30
8	Clip	.05	.10	.15	.20
9	Truss rod clip	.40	.50	.75	1 10
10	Pitman	.90	1.0	1.25	2.00
11	Swivel box	.50	.50	.75	1.10
11–1	Swivel box cap	.10	.25	.35	.50
12	Swivel	.65	.75	1.00	1 50
13	Weight	1.00	1.25	1.50	2.25
14	Gate Guard	.50	.75	1 00	1.50
15	Upper Guide	1.25	2 00	2.50	3 75
16	Lower Guide	.30	.50	.75	1.10
17	Thimble	1.50	2 50	2 75	4 00
18	Step	.75	1.00	1.25	1.90
19	Weight bar gear	.85	1.25	1.50	2.25
20	Sheave	.15	.30	.35	.50
21	Link	.25	.35	.40	.60
22	Sheave cover	.15	.20	.25	.35
23	Gear cover	.30	.50	.75	1.10
24	Piston rod	1.00	1.50	1.75	2.60
25	Rod and swivel	.40	.50	.75	1.10
26	Weight bar	1.00	1 50	1.75	2 60
27	Rudder vane bar	2.75	3.00	4.00	6.00
28	Truss rod	.30	.40	50	.75
29	Side vane bar	1 50	2.00	3.00	4.50
30	Stud	.35	.50	.75	1.25
31	Wrist pin	.35	.50	.75	1.25
32	Chain	.40	.50	.75	1.15
33	Counter poise	.60	.75	1.00	1.50
34	Pump connection	.40	.50	.75	1.10
	Wheel sections, each	(5) 2.25	(6) 2.50	(8) 2.75	(8) 4 00
	Ash arms, each	(5) .60	(6) .75	(8) .75	(8) 1.10
8	Ash arm braces				.75
	Large tail	5.00	7.00	9.00	13.50
	Small side vane	1.00	1.25	1.50	2 25
2	Long pump poles	.50	.50	.50	.75



PRICE LIST OF SPIKED WOODEN WINDMILL TOWERS.

Height.	Spruce.	Southern or Hard Pine.
36 Feet.	$28.00	$39.00
40 "	32.00	45.00
46 "	36.00	50.00
50 "	42.00	58.00
60 "	48.00	66.00
65 "	54.00	75.00

The above prices include all necessary nails and bolts.

PRICE LIST OF REPAIRS FOR 14-FOOT GEARED WINDMILLS.

No.			
1	Pivot Casting		$12.80
1-0	Top Socket Box		.40
1-1	Lower Socket Box		.40
1-2	Socket Shaft		2.50
2	Pivot Cap		1.90
3	Gate		5.40
3-1	Gate Clip		.30
3-2	Gate Pin		.40
4	Spider		7.00
4-0	Upper Pinion		1.20
4-1	Upper Gear		5.20
4-2	Shaft		3.50
4-3	Brace Plate		1.00
5	Outside Front Wheel Clip		.50
6	Outside Back Wheel Clip		.34
7	Inside Front Wheel Clip		.30
8	Inside Back Wheel Clip		.20
9	Truss Rod Clip		.70
9-1	Side Truss Rod Clip		.60
10	Pivot Pipe		6.80
11	Inside Pipe		3.30
12	Lever Arm		1.00
13	Pivot Gear		2.40
14	Segment		1.60
15	Cross-Head		1.00
16	Links, 2 @ 25		.50
17	Thimble		2.80
18	Pivot Step		1.30
19	Sockets, 2 @ 20		.40
20	Ball Pipe		.60
21	Shaft Box		.50
22	Box Ring	$1.80	.60
23	Box Stand		.70
24	Coupling		3.00
27	Vane Bar		4.00
28	Truss Rod		.60
29	Side Vane Bar		4.00

No.			
28-1	Side Truss Rods		$ .50
34	Pump Attachment		.90
35	Clutch Ring		
36	Clutch Guide	4.50	
37	Lever		
38	Lever Bearer		
39	Flat or Line Box		1.80
42 or 50	Pitman		1.00
44	Jack Frame		3.00
45	Fly Wheel		6.80
46	Pulley		3.90
47	Jack Pinion		.90
48	Pump Gear		6.00
49	Pump Pin		1.00
51	Knuckle		.90
52	Guide Pipe		.50
53	Pump Rod Sleeve		.60
54	Foot Gear		2.70
55	Foot Pinion		1.20
56	Foot Step		2.90
57	Vertical Box		.80
58	Vertical Box Cover		.30
59	Vertical Box Plate	$1.80	.50
60	Corner Clips for 4		.40
67	Strap Lever Fulcrum		1.30
68	Sector		.50
69	Stop Lever Socket	$4.00	1.20
70	Weight		1.00
71	Pump Pulley		4.70
72	Pulley Bearing		2.84
	8 Wheel Sections @ $4		32.00
	8 Arms and Bolts @ $1.10		8.80
	Rudder Vane		13.50
	Side Vane		2.25
	Out Gear Pole		1.20
	Cast Shipper Fork		.50
	8 Arm Braces, @ $ .75		6.00

ROUND RESERVOIR TANKS.

Made of 2-inch Selected Western Pine.

Length of Stave in feet.	Diameter of Bottom in Feet.	No. of Hoops.	Capacity in Gallons.	Capacity in Barrels.	Estimated Shipping Weight.	Price with Riveted Hoops.	Price with 1 pair Lugs on Hoops.
4	6	4	660	20	400	Unless otherwise specified, these sizes will be furnished with one pair Lugs on Hoops.	$ 23
5	6	4	849	25	550		27
5	7	4	1,075	38	750		31
6	6	5	1,038	30	750		31
6	8	5	1,899	57	950		40
7	5	6	754	24	875		29
7	7	6	1,592	50	950		40
7	8	6	2,127	70	1,100		45
8	6	6	1,306	41	900		38
8	8	6	2,450	77	1,300	$ 47	50
8	9	6	3,155	99	1,550	61	65
8	10	6	3,950	124	1,800	66	70
10	10	7	5,000	168	2,000	70	75
10	12	7	7,360	230	2,400	104	110
10	14	7	10,132	317	3,500	119	125
10	16	7	13,380	418	4,100	164	170
12	8	8	3,742	117	1,850	64	68
12	10	8	6,034	189	2,300	84	89
12	12	8	8,896	278	2,600	114	120
14	9	9	5,627	182	2,250	77	82
14	10	9	7,000	218	2,500	102	108
14	12	9	10,379	324	3,800	120	128

ROUND STORAGE TANKS.

Made of 3-inch Selected Western Pine.

Length of Stave in Feet.	Diameter of Bottom in Feet.	No. of Hoops.	Capacity in Gallons.	Capacity in Barrels.	Estimated Shipping Weight.	Price, with Riveted Hoops.	Price, with Lug Hoops.	No. of Pairs of Lugs on each Hoop.
10	10	7	4,992	168	3,200	$ 94	$100	2
10	12	7	7,360	251	4,200	132	140	2
12	10	8	6,034	202	3,800	112	120	2
12	12	8	8,896	295	4,800	150	160	2
12	14	8	12,285	390	5,800	178	190	2
12	16	8	16,191	514	6,700	213	225	2
12	18	9	20,696	657	7,500	259	275	3
14	10	9	6,989	235	3,700	116	125	2
14	12	9	10,379	344	5,300	168	180	2
14	14	9	14,333	455	6,500	210	223	2
14	16	10	18,994	603	7,500	239	255	2
14	18	10	24,289	771	8,600	310	335	3
14	20	10	30,146	957	11,000	341	365	3
16	16	12	21,798	692	8,000	295	310	2
16	18	12	27,878	885	9,500	345	375	3
16	20	12	34,619	1,099	12,500	360	390	3
16	22	12	42,084	1,336	13,000	405	435	3
16	24	12	50,272	1,596	14,000	420	450	3
18	24	13	56,763	1,802	15,000	440	475	3
18	30	14	89,066	2,784	25,500	600	645	3
20	24	16	63,252	2,008	16,000	515	560	3
20	30	16	99,666	3,164	28,000	650	700	3

This List covers only the most staple sizes. We are prepared to build Tan ks of any size, shape, or material.

ROUND RESERVOIR TANKS.

Made with 2-inch Staves, 3-inch Bottoms, Selected Western Pine.

Length of Stave in feet.	Diameter of Bottom in Feet.	No. of Hoops.	Capacity in Gallons.	Capacity in Barrels.	Estimated Shipping Weight.	Price with Riveted Hoops.	Price with 1 pair Lugs on Hoops.
10	10	7	5,000	168	2,100	$ 79	$ 83
10	12	7	7,360	230	2,500	115	120
10	14	7	10,132	317	3,700	135	140
10	16	7	13,380	418	4,400	184	190
12	8	8	3,742	117	1,950	62	68
12	9	8	4,823	151	2,050	67	73
12	10	8	6,034	189	2,500	90	96
12	12	8	8,896	278	2,800	127	133
12	14	8	12,285	390	4,000	166	173
12	16	8	16,191	514	5,100	204	212

PRICE LIST OF FIG. 50 DOUBLE-ACTING WINDMILL PUMPS.

Diameter of Cylinder.	Stroke.	Suction Pipe.	Discharge Pipe.	Price.
2½ Inch.	8 Inch.	1½ Inch.	1½ Inch.	$ 65.00
3 "	8 "	1½ "	1½ "	70.00
3 "	12 "	1½ "	1½ "	85.00
4 "	12 "	2 "	2 "	100.00
5 "	12 "	3 "	2½ "	120.00
5 "	16 "	3 "	2½ "	155.00

PRICE LIST OF FIG. 35 SINGLE-ACTING WINDMILL PUMPS.

Sizes.	Diameter Inner Cylinder.	Stroke.	Suction and Discharge.	Price.
No. 0	2 Inch.	8 Inch.	1¼ Inch.	$18.00
" 1	2½ "	8 "	1¼ "	22.00
" 2	3 "	8 "	1½ "	28.00
" 3	4 "	10 "	2 "	50.00

PRICE LIST OF FIG. 320 SINGLE-ACTING WINDMILL PUMPS.

No.	Size Cylinder.	Suction.	Discharge.	Brass Lined Cylinder.	Brass Cylinder.
1	2½ Inch.	1½ Inch.	1¼ Inch.	$17.00	$18.25
2	3 "	1½ "	1½ "	17.25	18.75
3	3½ "	2 "	2 "	18.00	20.75

PRICE LIST OF FIG. 500 SINGLE-ACTING WINDMILL PUMPS.

No.	Size Cylinder.	Suction and Discharge Fitted for	Stroke.	PRICE. Iron.	PRICE. Brass.
1	2 Inch.	1 Inch Pipe.	7 Inch.	$7.50	$16.00
2	2½ "	1¼ " "	7 "	8.00	18.00
3	3 "	1¼ " "	7 "	8.50	20.00

Stock Tanks, Dye Vats and Tubs.

Length of Stave in Feet.	Diameter of Bottom in Feet.	Number of Hoops.	* Capacity in Gallons.	2-Inch Stock.		3-Inch Stock.	
				Price with Lug Hoops.	Estimated Shipping Weight.	Price with Lug Hoops.	Estimated Shipping Weight.
2	4	2	115	$ 9.50	215	$12.75	300
2	5	2	192	11.00	265	14.50	370
2	5½	2	231	12.00	300	16.00	420
2	6	2	283	13.50	340	18.00	475
2	7	2	391	17.00	390	22.50	540
2	8	2	518	20.00	450	26.00	630
2	9	2	662	22.50	530	30.00	740
2	10	2	824	25.00	650	33.50	910
2½	5	2	257	12.00	325	16.00	550
2½	5½	2	313	13.50	350	17.50	575
2½	6	2	377	15.00	375	19.00	600
2½	7	2	522	18.00	445	25.00	660
2½	8	2	682	21.00	525	28.00	750
2½	10	2	1,098	27.00	775	35.50	1,000
3	3	3	105	12.00	200	16.00	280
3	4	3	197	13.50	225	17.50	315
3	5	3	320	16.00	285	22.50	400
3	6	3	472	19.00	380	25.50	530
3	7	3	653	22.00	490	29.00	685
3	8	3	863	26.00	620	34.50	865
4	4	4	272	14.50	300	20.00	425
4	5	4	448	18.50	340	24.50	476
4	6	4	660	23.00	400	30.50	560
4	7	4	914	28.00	500	36.00	700
4	8	4	1,209	32.00	740	43.00	1,035
4	9	4	1,545	36.00	870	49.50	1,210
5	4	4	356	17.50	350	23.00	490
5	5	4	576	22.50	490	29.50	685
5	6	4	849	27.00	550	35.50	770
5	7	4	1,175	31.00	750	41.00	1,050
5	8	4	1,555	36.50	970	47.00	1,350
5	9	4	1,986	41.00	1,200	54.00	1,680
5	10	4	2,471	45.50	1,450	61.00	2,000
6	4	5	434	20.00	420	26.50	590
6	4½	5	561	23.00	490	31.00	685
6	5	5	752	26.00	570	34.00	800
6	5½	5	863	28.00	650	38.00	910
6	6	5	1,038	31.00	750	41.50	1,050
6	7	5	1,436	34.00	850	45.00	1,190
6	8	5	1,899	40.00	950	54.50	1,330
6	9	5	2,427	47.00	1,300	62.00	1,820
6	10	5	3,120	55.00	1,550	70.00	2,170

* The capacities are figured on the inside measurements of the tanks; there is, however, a slight taper, varying in the different tanks, for which no exact allowance can be made; the rated capacities are, therefore, a little in excess of the actual.

PRINTED BY
H. C. MANDELL & CO.
BOSTON.

WIND MILL WORLD
ECLIPSE
TRADE 1867 MARK
BELOIT, WIS.

ENGRAVED BY
FRANKLIN ENGRAVING CO.
BOSTON.